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# Instruction Manual

FLUKE

ELECTRONICS FOR INDUSTRY
INSTRUMENTS / COMPONENTS

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P.O. Box 7428 Seattle, Washington 98133

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# MODEL 873A, 873AB
## AC/DC DIFFERENTIAL VOLTMETER

873A & 873AB serial no. 123 and above.

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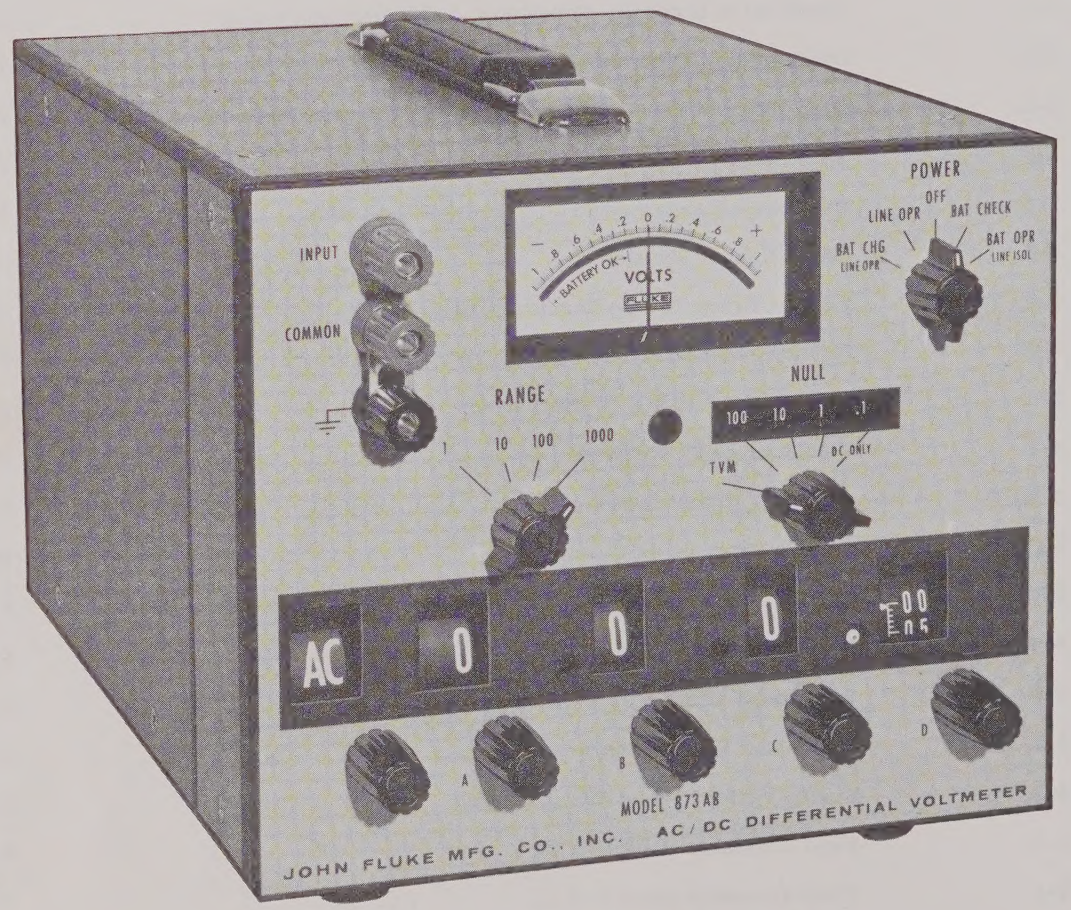



MODEL 873AB AC/DC DIFFERENTIAL VOLTMETER

# SECTION I

# INTRODUCTION AND SPECIFICATIONS

## 1-1. INTRODUCTION

1-2. This instruction manual is for use with the 873A series AC/DC Differential Voltmeters. This instrument is available as either line-powered (Model 873A), or as a combination line-powered/battery-powered instrument (Model 873AB). Both instruments are half rack size and are equipped with rubber feet and tilt-up bail for field or bench use. A single instrument may be mounted in a standard 19 inch rack by means of metal handle rack adapter kit 881A-102. Two instruments may be mounted side-by-side by means of metal handle rack adapter kit 881A-103.

1-3. The 873A series instruments are capable of being used as: (a) Conventional voltmeters for rapid determination of ac and dc voltages from 0 to 1100 volts to within 3% of range setting. (b) Differential voltmeters for precise measurement of ac and dc voltages from 0 to 1100 volts, and (c) Megohmmeters for measurement of resistance from 10 megohms to 100,000 megohms with a typical accuracy of 5%. The instrument can also be used to measure the excursion of an ac or dc voltage about a nominal value. In measuring dc voltages equal to or less than 11 volts, no current is drawn from the unknown voltage source at null. Thus, the determination of the unknown potential is independent of its source resistance. Above 11 volts, the dc input resistance is 10 megohms. AC input impedance is 1 megohm in parallel with 40 pf. To minimize errors due to common mode voltages, the 873A series is provided with extremely high dc leakage resistance to ground, typically several hundred thousand megohms. Where ground loop current may be present, complete isolation from the power line through battery operation of the 873AB eliminates this source of error. The 873A series contains a polarity switch for equal convenience in measuring positive or negative dc voltages, or ac voltages. An adjustable recorder output is also provided for monitoring the meter deflection. Shock, vibration, humidity, and temperature testing assure years of hard use under severe environmental conditions.

1-4. When used as a differential voltmeter, the 873A and 873AB operate on the potentiometric principle. An unknown voltage is measured by comparing it to a known adjustable dc voltage with the aid of a null detector and, for ac measurements, an ac to dc converter. An accurate standard for measurement is obtained from an 11 volt reference supply derived from a pair of temperature-compensated zener diodes. The known adjustable reference voltage is provided by a Kelvin-Varley voltage divider with three decades of Fluke precision wirewound resistors and an interpolating vernier potentiometer, which are set accurately by four voltage readout dials to provide a five digit readout. In this way, the 11 volts can be precisely divided into increments of 10 ppm of range. At null, the unknown voltage is indicated by the voltage dials. For dc voltages between 11 and 110 volts, an input attenuator divides the unknown voltage by 10 before it is measured potentiometrically; for dc voltages between 100 and 1100 volts, the input attenuator divides the unknown voltage by 100.

## 1-5. INPUT POWER

1-6. The voltmeter is usually supplied with the primary windings of the power transformer connected in parallel for operation from 115 volts ac. Upon request, the instrument is supplied with the primary windings connected in series for operation from 230 volts. If it becomes desirable to convert from one operating voltage to the other, refer to the schematic diagram and the decal on the power transformer.

## 1-7. RECEIVING INSPECTION

1-8. This instrument has been thoroughly tested and inspected before being shipped from the factory. Immediately after receiving the instrument, carefully inspect for damage which may have occurred in shipment. If any damage is noted, follow the instructions outlined in the warranty page at the back of this manual.

## 1-9. SPECIFICATIONS

### AS A DIFFERENTIAL VOLTMETER

DC ACCURACY: ±(0.02% of input voltage + 0.001% of range) from 0 to 1100 vdc.

AC ACCURACY:

20 Hz to 10 kHz
±(0.2% of input + 25 uv) from 0.001 to 1100 v.
10 kHz to 20 kHz
±0.3% of input from 0.1 to 1100 v.
10 Hz to 20 Hz
±(0.3% of input + 25 uv) from 0.001 to 1100 v.
20 kHz to 50 kHz
±1% of input from 0.1 to 110 v.
5 Hz to 10 Hz
±(1% of input + 25 uv) from 0.001 to 1100 v.
50 kHz to 100 kHz
±2% of input from 0.1 to 110 v.

INPUT RANGES: 1, 10, 100, and 1000 volts, ac and dc, with 10% over-ranging.

NULL RANGES:

| Input Voltage Range | Null Ranges | Input Resistance at Null | |
|---|---|---|---|
| | | dc | ac |
| 1 v | .1, .01, .001 v | Infinite | 1 megohm, 40 pf |
| 10 v | 1, .1, .01, .001 v | Infinite | 1 megohm, 40 pf |
| 100 v | 10, 1, .1, .01 v | 10 megohms | 1 megohm, 40 pf |
| 1000 v | 100, 10, 1, .1 v | 10 megohms | 1 megohm, 40 pf |

VOLTAGE DIAL RESOLUTION:

| Voltage Range | Resolution | |
|---|---|---|
| | ppm of range | volts |
| 1 v | 10 ppm | 10 uv |
| 10 v | 10 ppm | 100 uv |
| 100 v | 10 ppm | 1 mv |
| 1000 v | 10 ppm | 10 mv |

METER RESOLUTION:

| Meter Resolution (1/2 of a small scale division) | |
|---|---|
| Null Range | Resolution |
| .001 | 10 uv |
| .01 | 100 uv |
| .1 | 1 mv |
| 1 | 10 mv |
| 10 | 100 mv |
| 100 | 1 v |

### AS A CONVENTIONAL VOLTMETER

DC ACCURACY: ±3% of range.

AC ACCURACY: ±3% of range within frequency and voltage ranges listed under ac accuracy as a differential voltmeter.

RANGE AND INPUT IMPEDANCE:

| Voltage Range | Input Impedance | |
|---|---|---|
| | dc | ac |
| 1000-0-1000 | 10 megohms | 1 megohm, 40 pf |
| 100-0-100 | 10 megohms | 1 megohm, 40 pf |
| 10-0-10 | 10 megohms | 1 megohm, 40 pf |
| 1-0-1 | 10 megohms | 1 megohm, 40 pf |
| *.1-0-.1 | 10 megohms | 1 megohm, 40 pf |
| *.01-0-.01 | 10 megohms | 1 megohm, 40 pf |
| *.001-0-.001 | 1 megohm | 1 megohm, 40 pf |

NOTE: 10% over-ranging on each range.
*These ranges obtained by using null ranges with all readout dials set to zero.

## GENERAL

POLARITY: Front panel switch selects +dc, -dc, or ac.

ELECTRICAL DESIGN: Completely solid-state.

INPUT RESISTANCE OF NULL DETECTOR: 10 megohms on two highest null ranges for all input ranges; 1 megohm on two lowest null ranges for all input ranges.

REFERENCE ELEMENT: Temperature-compensated zener diode, stability within ±50 ppm per year, and temperature coefficient less than 5 ppm/° C.

REGULATION OF REFERENCE SUPPLY: ±0.001% for a ±10% line voltage change.

STABILITY OF REFERENCE SUPPLY: ±0.002% per hour after a 5-minute warmup.

ACCURACY OF OFF-NULL DEFLECTION: ±5% of null range (±3% with voltage dials at zero).

KELVIN-VARLEY ACCURACY: ±0.01% of output from 1/11 of full scale to full scale. Ratio stability of decade resistors, ±25 ppm/year.

RECORDER OUTPUT: Adjustable from 0 to at least +20 mv for full scale right deflection, and from 0 to at least -20 mv for full scale left deflection.

WARMUP TIME: dc - 15 seconds; ac - 1 minute.

RELATIVE HUMIDITY: 0 to 80%.

COMMON MODE REJECTION: 130 db at dc; 85 db at 60 Hz; 70 db at 400 Hz.

NOTE: Battery operation of the 873AB provides complete isolation from power system ground, which eliminates errors due to ground loops.

OPERATING TEMPERATURE RANGE: Within dc accuracy specifications from 50° F to 104° F (10° C to 40° C); Within ±(0.05% of input voltage + 10 uv) dc accuracy outside these limits to 32° F and 122° F (0° C and 50° C).

Within ac accuracy specifications from 55° F to 95° F (13° C to 35° C), derated at ±0.005%/° F outside these limits to 32° F and 122° F (0° C and 50° C).

STORAGE TEMPERATURE RANGE: Model 873A, -40° F to +158° F (-40° C to +70° C). Model 873AB, -40° F to +140° F (-40° C to +60° C).

SHOCK AND VIBRATION: Meets requirements of MIL-T-945A and MIL-S-901B.

INPUT POWER: Model 873A - 115/230 vac ±10%, 50-440 Hz; Model 873AB - 115/230 vac ±10%, 50 - 440 Hz and rechargeable battery operation (minimum 30 hours operation on full charge).

SIZE: 7" high x 8-1/2" wide x 11-3/4" deep.

WEIGHT: Model 873A - approximately 12 lbs.
Model 873AB - approximately 14 lbs.

# SECTION II

# OPERATING INSTRUCTIONS

## 2-1. FUNCTION OF CONTROLS, TERMINALS AND INDICATORS

2-2. The location, reference designation, and a functional description of the external controls, terminals, and indicators on the 873A/873AB AC/DC Differential Voltmeter is given in Figures 2-1 and 2-2.

## 2-3. PRELIMINARY OPERATION–MODEL 873A

2-4. The following procedure prepares the Model 873A for operation.

a. Mechanically zero the meter with the adjustment screw on the front panel. If the instrument has been operating, it must be shut off for at least three minutes, with the meter terminals shorted, prior to this adjustment.

b. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

***WARNING!***

The round pin on the polarized three-prong plug connects the instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact outlet. For personnel safety, connect the short lead to a high-quality ground.

c. Set switches on 873A as follows:

| | |
|---|---|
| RANGE | 1000 |
| NULL | TVM |
| polarity | + (positive) |
| all voltage readout dials | zero |
| POWER | ON |

## 2-5. PRELIMINARY OPERATION– MODEL 873AB

2-6. The following procedure prepares the Model 873AB for operation.

a. Mechanically zero the meter with the adjustment screw on the front panel. If the instrument has been operating, it must be shut off for at least three minutes, with the meter terminals shorted, prior to this adjustment.

b. For line operation, connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

***WARNING!***

The round pin on the polarized three-prong plug connects the instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact outlet. For personnel safety, connect the short lead to a high-quality ground.

c. For line operation, set the POWER switch to LINE OPR.

d. For battery operation, set the POWER switch to BAT CHECK. Meter needle should deflect to BATTERY OK region. If meter needle does not stay within BATTERY OK region for 10 seconds, charge batteries as outlined in paragraph 2-9. If batteries are adequately charged, set POWER switch to BAT OPR-LINE ISOL.

e. Set switches on 873AB as follows:

| | |
|---|---|
| RANGE | 1000 |
| NULL | TVM |
| polarity | + (positive) |
| all voltage readout dials | zero |

## 2-7. ZEROING INSTRUCTIONS

2-8. If the meter needle indicates off zero at rest, it can be due to either incorrect mechanical zero or incorrect electrical zero. The meter can be zeroed as follows:

a. Short across the internal meter terminals, and adjust the mechanical zero control for meter null.

b. Short INPUT post to COMMON post.

c. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 1 |
| NULL | .001 |
| polarity | + (positive) |
| all voltage readout dials | zero |

d. Set POWER switch to ON with 873A, or to LINE OPR with 873AB, and allow the instrument to warmup for 1 minute.

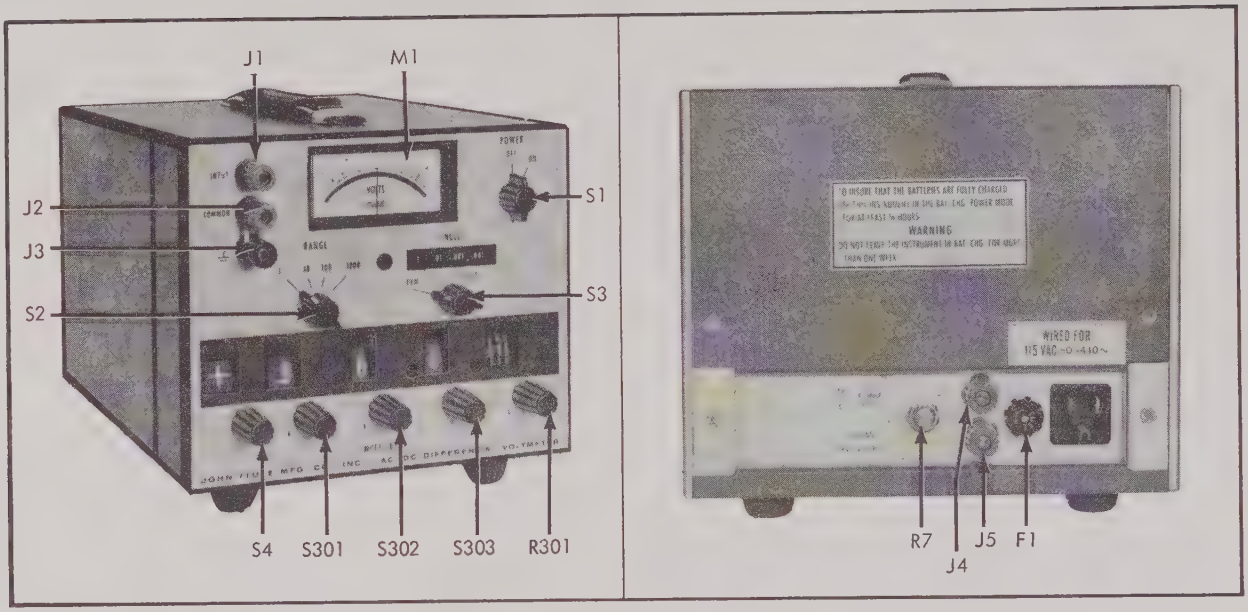



Figure 2-1. LOCATION OF CONTROLS, TERMINALS, AND INDICATORS

| CONTROLS TERMINALS AND INDICATORS | REFERENCE DESIGNATION | FUNCTIONAL DESCRIPTION |
|---|---|---|
| INPUT and COMMON terminals | J1, J2 | Provided for connecting voltage to be measured. |
| Chassis ground terminal | J3 | Provided for grounding purposes. A 0.01 uf capacitor is connected from the COMMON binding post to the chassis ground post. To prevent possible incorrect measurements, the INPUT post should never be connected to the chassis ground post. Since the instrument is equipped with a three-wire line cord with the third wire fastened to the chassis, the circuit should be checked for conflicts in grounding before connecting the COMMON binding post to the chassis post. |
| POWER switch | S1 | In the Model 873A, the POWER switch applies ac line voltage to primary circuit of transformer T1 when turned from OFF to ON. In the Model 873AB, positions for BAT CHECK, and three modes of operation (LINE OPR, BAT CHG - LINE OPR, and BAT OPR - LINE ISOL) are available. When set to LINE OPR, ac line voltage is applied to primary circuit of transformer. When set to BAT CHG - LINE OPR, ac line voltage is applied to primary of transformer and batteries are charged at the same time. When set to BAT OPR - LINE ISOL, battery power is applied to the instrument and both sides of primary circuit are open. When set to BAT CHECK, battery power is applied to the instrument, both sides of primary circuit are open, and meter is connected in series with a resistor to measure voltage drop across the series regulating transistor, Q101, which indicates the condition of the batteries. |
| RANGE switch | S2 | Selects desired voltage range, changes null ranges appearing in NULL window, and positions decimal point for voltage readout dials. Voltage ranges of 1, 10, 100, and 1000 volts are available. A voltage 10% higher than range setting may be measured in each range. |

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 2)

| CONTROLS TERMINALS AND INDICATORS | REFERENCE DESIGNATION | FUNCTIONAL DESCRIPTION |
|---|---|---|
| NULL switch | S3 | Set to TVM for determining the approximate value of unknown voltage prior to differential measurements. Six null voltage ranges of 100, 10, 1, 0.1, 0.01, and 0.001 volts are used for differential measurements. These ranges represent full scale differences between the unknown voltage and the amount of precision internal reference voltage that is set on the voltage readout dials. |
| A, B, C, and D voltage readout dials | S301, S302, S303, R301 | Provide in-line readout of the internal reference voltage. |
| Polarity switch | S4 | Connects ac to dc converter for measurement of ac voltage, and changes polarity of voltmeter to match polarity of unknown for measurement of dc voltage. With this switch in the positive position, the polarity of INPUT binding post is positive with respect to COMMON binding post. |
| Mechanical zero control | None | Sets meter to zero mechanically. This adjustment should be used only after instrument has been turned off for at least three minutes and when the internal meter terminals have been shorted. |
| Meter | M1 | Indicates approximate voltage when voltmeter is in TVM mode and difference between unknown and internal reference voltage when voltmeter is in differential mode. |
| RECORDER OUTPUT terminals | J4, J5 | Provided for attaching a recorder to monitor voltage excursions. |
| AMP ADJ control | R7 | Varies the output level of the recorder output binding post from 0 to at least 20 millivolts at full scale deflection. |
| Fuse | F1 | Fuse holder protrudes from instrument to provide easy access to the fuse. The fuse is a 1/16 ampere slow blowing type for 115 volt operation and a 1/32 ampere slow blowing type for 230 volt operation of 873A. Fuse is a 1/8 ampere slow blowing type for 873AB. |

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 2)

e. Remove the short from the internal meter terminals. Meter offset should be less than 1/4 small scale division in both dc polarities: if not, adjust R227 as necessary to zero the meter.

f. Remove the short between the INPUT and COMMON posts. Meter offset should remain within 1/3 small scale division in both dc polarities.

## 2-9. BATTERY CHARGING

a. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

b. Set POWER switch to BAT CHG-LINE OPR. After 16 hours, batteries will be fully charged and capable of operating the instrument for at least 30 hours. The instrument may be operated while the batteries are being charged.

***CAUTION!***

Since overcharging decreases battery life, it is recommended that the batteries be charged for less than 48 hours, and never more than 1 week. When used properly, the batteries will give more than 200 charge-discharge cycles.

## 2-10. OPERATION AS A DC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Connect unknown voltage between INPUT and COMMON post. If one side is grounded, always connect it to the COMMON post.

c. Turn RANGE switch to lowest range that will permit on-scale meter deflection, and note approximate value of unknown voltage.

d. If meter deflects to the left, the polarity of the unknown voltage is negative. Turn polarity switch to

the negative position. The meter will deflect to the right.

e. Noting position of decimal point, set four voltage readout dials to the approximate voltage determined in step c. For example, if the approximate voltage was 35 volts, decimal point will be between the B and C readout dials. Therefore, set dial A to 3 and dial B to 5.

f. Set the NULL switch from TVM to the first null position for the range being used, and adjust the readout dials for zero meter deflection.

g. Adjust the readout dials for zero meter deflection in successively more sensitive null ranges. When the meter needle deflects to the right, the magnitude of the voltage under measurement is greater than the voltage set on the readout dials. When deflection is to the left, the voltage under measurement is less than the voltage set on the readout dials.

h. When the meter is at null on the most sensitive null range, the unknown voltage equals the value set on the four readout dials.

## 2-11. OPERATION AS AN AC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Set polarity switch to AC.

c. Connect unknown ac voltage between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.

d. Set RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on meter scale.

e. Noting the position of the decimal point, set four voltage readout dials to approximate voltage determined in step d. For example, if the voltage is approximately 35 volts, the decimal point will already be between the B and C voltage readout dials. Therefore, set dial A to 3 and set dial B to 5.

f. Set NULL switch to successively more sensitive null ranges and adjust voltage readout dials for zero meter deflection in each null position. When meter needle indicates to the right, magnitude of voltage being measured is greater than voltage set on voltage readout dials. When indication is to the left, voltage is less than that set on the readout dials.

g. Read unknown voltage directly from the four voltage readout dials.

## 2-12. OPERATION AS A CONVENTIONAL VOLTMETER

2-13. If it is desired to use the instrument as a conventional 3% voltmeter only, additional ranges can be made available by converting the NULL ranges to conventional voltmeter ranges. This is made possible by setting the voltage readout dials to zero, and setting the range switch to 1 volt. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Refer to Figure 2-3, and select full scale voltage deflection desired. If approximate value of voltage to be measured is unknown, select the 1000 volt range initially.

c. Set RANGE switch, NULL switch, and voltage dials as indicated in Figure 2-3 for the range selected.

d. Connect voltage to be measured between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post. Deflection to the right indicates that the unknown dc voltage is of positive polarity. An unknown ac voltage will always cause deflection to the right.

| FULL-SCALE DEFLECTION (VOLTS) | POLARITY SWITCH POSITION | RANGE SWITCH POSITION | NULL SWITCH POSITION | VOLTAGE READOUT DIAL POSITIONS |
|---|---|---|---|---|
| DC: | | | | |
| 1000-0-1000 | + | 1000 | TVM | No effect |
| 100-0-100 | + | 100 | TVM | No effect |
| 10-0-10 | + | 10 | TVM | No effect |
| 1-0-1 | + | 1 | TVM | No effect |
| .1-0-.1 | + | 1 | .1 | All zero |
| .01-0-.01 | + | 1 | .01 | All zero |
| .001-0-.001 | + | 1 | .001 | All zero |
| AC: | | | | |
| 0-1000 | AC | 1000 | TVM | No effect |
| 0-100 | AC | 100 | TVM | No effect |
| 0-10 | AC | 10 | TVM | No effect |
| 0-1 | AC | 1 | TVM | No effect |
| 0-.1 | AC | 1 | .1 | All zero |
| 0-.01 | AC | 1 | .01 | All zero |
| 0-.001 | AC | 1 | .001 | All zero |

Figure 2-3. TVM RANGES

## 2-14. MEASUREMENT OF VOLTAGE EXCURSIONS ABOUT A NOMINAL VALUE

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
b. Set polarity switch to desired position.
c. Connect voltage to be measured between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post. Deflection to the left indicates that the voltage being measured is negative; set polarity switch to the negative position. This will cause meter pointer to deflect to the right.
d. Measure nominal value of voltage to be observed by setting RANGE switch to lowest range possible without driving meter deflection off-scale.
e. Set four voltage readout dials to nominal value measured in step d.
f. Set NULL switch to maximum sensitivity possible without driving voltage excursions off-scale.
g. Voltage excursions are indicated by meter. Note that full scale right and left meter deflections are equal to the NULL range setting (disregarding 10% overranging). Meter deflection to the right indicates that the magnitude of voltage under observation has increased above the nominal value; deflection to the left indicates voltage has decreased below nominal value.

## 2-15. RECORDING VOLTAGE EXCURSIONS

2-16. Recorder output binding posts and an output level control are provided on the 873A and 873AB for monitoring the excursions of an unknown voltage from the voltage indicated by the voltage readout dial settings. If the leakage resistance between the recorder and ground is less than 10,000 megohms, the accuracy of the voltmeter will be impaired. Therefore, the FLUKE Model A88 Isolation Amplifier is recommended for this application. The A88 will allow the use of a wide range of inexpensive recorders for recording voltmeter deflection, without regard to the input isolation characteristics of the recorder.

## 2-17. USE OF 873A WITH AN A88 ISOLATION AMPLIFIER AND A RECORDER

2-18. To use the Fluke A88 Isolation Amplifier and a recorder with the 873A or 873AB, proceed as follows:

a. Set A88 POWER switch to ON.
b. When batteries are being used as a power source for A88, measure voltage at BATT TEST jacks. If voltage is between 11.7 and 14 volts DC, the batteries are satisfactory for use. However, if battery voltage is below 12.5 volts, batteries are approaching end of their useful life and should be replaced.
c. Connect RECORDER OUTPUT terminals of differential voltmeter to INPUT terminals of isolation amplifier with teflon leads.
d. Connect OUTPUT terminals of isolation amplifier to recorder input terminals.
e. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
f. Short INPUT post to COMMON post and set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 10 |
| NULL | 1 |
| voltage readout dials | 1.00 00 |

The meter will indicate full scale (-1.0).
g. Turn on the recorder and set recorder gain for a full scale sensitivity equal to or less than 2 volts, but as close to 2 volts as possible.
h. Adjust AMP ADJ control on rear of differential voltmeter until recorder deflection obtained is that desired to correspond to full scale deflection of the differential voltmeter.
i. Remove short from INPUT to COMMON post. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed according to paragraph 2-14.

## 2-19. USE WITH A RECORDER

2-20. To use a recorder with the 873A or 873AB, proceed as follows:

a. Using teflon insulated leads, connect RECORDER OUTPUT terminals of differential voltmeter to input terminals of recorder.

*Note!*

Do not ground either of the voltmeter RECORDER OUTPUT terminals or either of the recorder input terminals. If any of these terminals are grounded, current will be drawn from the Kelvin-Varley divider and the voltmeter will no longer be accurate.

b. Perform preliminary operation as stated in paragraph 2-3 or 2-5.
c. Check for excessive electrical leakage as follows:

(1) Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 10 |
| NULL | .001 |
| polarity | + (positive) |
| voltage readout dials | 10.0000 |

(2) Connect either recorder lead to the INPUT binding post, and connect the common side of the voltage to be measured to the COMMON binding post. A deflection of more than full scale (-1.0) indicates excessive leakage.
d. Short INPUT post to COMMON post and set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 10 |
| NULL | 1 |
| voltage readout dials | 1.00 00 |

The meter will indicate full scale (-1.0). This provides a maximum of at least 20 millivolts at the RECORDER OUTPUT terminals depending on the setting of the AMP ADJ control. Reconnect recorder to RECORDER OUTPUT terminals.
e. Adjust AMP ADJ control until recorder deflection obtained is that desired to correspond to full scale deflection of the voltmeter.

f. Remove short between INPUT and COMMON posts, and connect voltage to be measured to INPUT and COMMON posts. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed according to paragraph 2-14.

## 2-21. MEASUREMENT OF HIGH RESISTANCE

2-22. The 873A series voltmeter may be used as a megohmmeter for rapid measurements of high resistances from 10 megohms to 100,000 megohms with a typical accuracy of 5%. The following equation may be used to compute the resistance in megohms of an unknown connected to the input binding posts when the RANGE switch is set to 10.

$$R_x = R_i \left(\frac{E}{E_m} - 1\right) \text{ megohms}$$

Where:

$R_x$ is the unknown resistance in megohms.

E is the voltage indicated by the voltage readout dials.

$E_m$ is the voltage indicated on the meter.

$R_i$ is the input resistance of the TVM circuit in megohms and is 10 for the 1 and 0.1 null range and 1 for the 0.01 and 0.001 null range on the 10 volt range.

2-23. A convenient way of measuring leakage resistance between 10 megohms and 11,000 megohms is to adjust the voltage readout dials so that the meter indicates full scale (-1.0). The unknown resistance is then easily calculated from the readout dial setting. Proceed as follows:

a. Perform preliminary operation, paragraph 2-3 or 2-5.
b. Set RANGE switch to 10.
c. Set NULL switch to 1.
d. Connect unknown resistance between INPUT post and COMMON post. Use short insulated leads to prevent measuring the leakage resistance between the leads.
e. Adjust voltage readout dials for full scale meter deflection (-1.0). If full scale deflection cannot be obtained with NULL switch set to 1, set NULL switch to 0.1 or 0.001.
f. Determine value of unknown resistance according to Figure 2-4.

## 2-24. NOTES ON OPERATION OF 873A AND AB

### 2-25. GROUND LOOP PRECAUTIONS

2-26. Ground loop currents should be avoided to assure measurement accuracy. A potential difference often exists between different points on power system grounds. When this occurs, current may flow from the power system ground through the voltmeter and the equipment being measured and back to the power system ground. To prevent ground loop currents when the system being measured is grounded, do not connect COMMON post to chassis ground post.

### 2-27. USE OF SHORTING LINK

2-28. An 0.01 uf capacitor (C1) is connected from the COMMON binding post to the chassis ground binding post, which reduces the effect of circulating ac currents from the transformer. In some cases, it is possible for C1 to acquire a charge. For example, C1 will become charged when making measurements in the presence of common mode voltages. This charge may cause an error on subsequent low level measurements (under 5 volts), due to C1 discharging through the Kelvin-Varley divider and leakage resistance to ground. Connecting the shorting link from the COMMON post to the ground post for a few seconds will discharge C1 and thus prevent an incorrect indication.

### 2-29. CHECKING BATTERIES OF 873AB

2-30. If the 873AB is turned off with the batteries completely discharged, the battery voltage may recover with time. It is possible for the batteries to recover sufficiently for the meter to indicate that they are charged, when the power switch is first set to battery check. However, after a few seconds, the battery voltage will fall, and the meter will indicate that the batteries need to be charged. It should be noted that the discharge characteristic of nickel-cadmium batteries is nearly flat, except near full charge and complete discharge. Therefore, when the batteries are checked, the meter indication is not proportional to the remaining ampere-hour capacity of the batteries. Just after the batteries are charged, the meter will indicate near full scale. However, most of the time the meter will indicate near half scale. A few hours before the batteries need recharging, the meter needle will indicate just within the BATTERY OK region.

| RANGE OF UNKNOWN RESISTANCE | NULL SWITCH POSITION | UNKNOWN RESISTANCE IN MEGOHMS AT FULL-SCALE (-1.0) METER DEFLECTION |
|---|---|---|
| 10 megohms to 100 megohms | 1 | Multiply amount set on voltage readout dials by 10 and subtract 10. |
| 90 megohms to 1090 megohms | 0.1 | Multiply amount set on voltage readout dials by 100 and subtract 10. |
| 1000 megohms to 11,000 megohms | 0.001 | Multiply amount set on voltage readout dials by 1000. |

Figure 2-4. RESISTANCE MEASUREMENTS AT FULL SCALE DEFLECTION

## 2-31. NOTES ON MEASURING DC VOLTAGES

### 2-32. AFFECT OF AC COMPONENTS ON DC MEASUREMENTS

2-33. An ac voltage of several times the unknown dc voltage can be present on the unknown and the 873A or 873AB will indicate well within the specifications, if the frequency is over a few hundred cycles. A double-section, low-pass filter (R201, C201, R202, and C202) at the input of the null detector reduces any ac present on the dc being measured. At lower frequencies, this low-pass filter is less effective, and the magnitude of the ac component may be significant. If the low frequency ac component is equal to or less than 1000 times the null range being used, no perceptable error will result. For example, on the .01 volt null range, a 60 Hz ac voltage of up to 10 volts will cause no perceptable error. When the frequency is very close to a multiple or submultiple of the chopper frequency (approximately 84 Hz), the meter needle will oscillate at the difference frequency. If ac components that affect the accuracy are ever encountered, additional filtering at the input of the instrument will be necessary. For alternating current of a single frequency, a twin-T filter is effective, and has low total series resistance. For an alternating current of various frequencies, an ordinary low pass filter may be used. In either case, the filter should be constructed of high quality capacitors which have high leakage resistance.

### 2-34. EFFECT OF DC COMMON MODE VOLTAGE

2-35. Care has been taken in the design and construction of the 873A to isolate the circuitry from chassis ground. Accurate dc measurements can be made with the 873A and 873AB in the presence of common mode voltages of up to 1000 volts dc. The dc common mode rejection is at least 130 db (3,160,000 to 1), or 0.35 uv error per common-mode-volt, up to 70% relative humidity. Since the leakage resistance varies inversely with dampness, the dc common mode error is typically much less at lower relative humidity. If the common mode voltage is greater than 50 volts, the measurement should be made several minutes after hookup for best accuracy. This is due to the time required to charge stray capacitance through the extremely high resistance to ground.

### 2-36. MEASUREMENT OF NEGATIVE VOLTAGES

2-37. Because of the polarity switch, voltage which is negative with respect to common, as well as voltage which is positive, can be measured with equal facility. If the INPUT binding post is connected to ground, either at the front panel or at the source being measured, the accuracy of the voltmeter may be reduced. If the unknown voltage is negative, always connect the grounded side to the COMMON post, and use the polarity switch to obtain the proper result.

### 2-38. OFF-NULL DC INPUT RESISTANCE

2-39. At null on the two lowest dc ranges the input impedance of the instrument is infinite, since no current flows from the unknown. However, when the meter is off null on the two lowest ranges a small dc current will flow. The apparent dc input resistance on the 1 volt and 10 volt ranges for off-null meter deflection is given in Figure 2-5. The ac input impedance is, of course, 1 megohm in parallel with 40 pf.

## 2-40. NOTES ON MEASURING AC VOLTAGES

### 2-41. ERRORS DUE TO DISTORTION

2-42. The ac to dc converter in the 873A is an average responding device calibrated to rms. The converter will provide a dc output voltage that is proportional to 1.11 times the average value of the ac input voltage. Thus, if the input signal is not a true sinusoid, the 873A reading is probably in error because the ratio of rms voltage to average voltage is usually not the same in a complex wave as in a sine wave. The magnitude of the error is dependent on the magnitude of the distortion and on its phase and harmonic relationship to the funda-

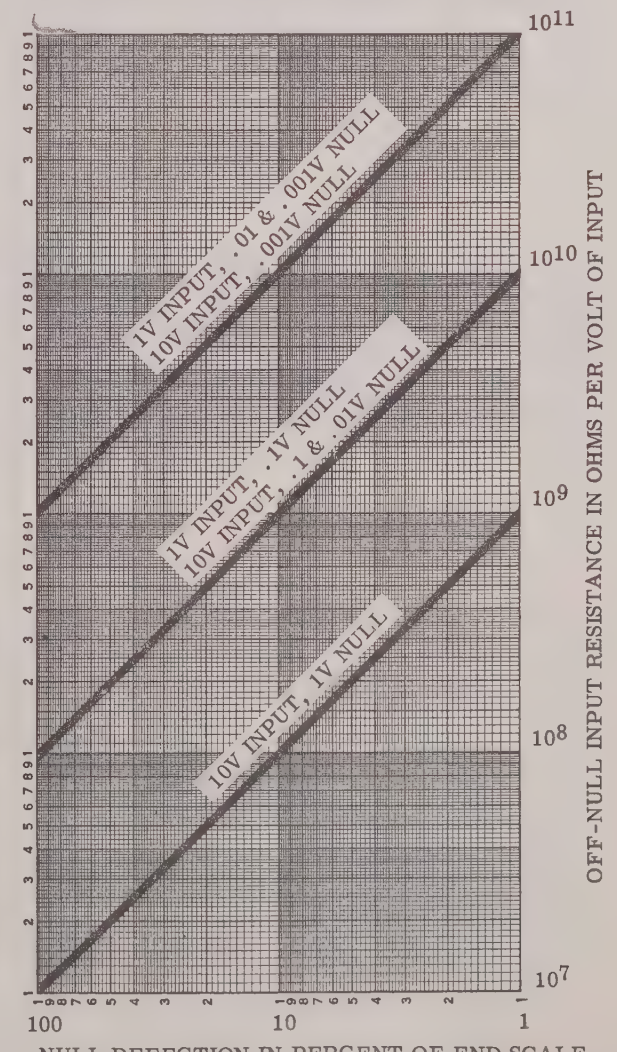



Figure 2-5. OFF-NULL INPUT RESISTANCE

mental. Figure 2-6 indicates how the accuracy is affected by various harmonics for different percentages of distortion. If the distortion present in the signal is composed of even harmonics and is less than 2%, the error between the 873A reading and true rms is fairly minor. A larger error can occur if the distortion is composed of odd harmonics, especially the third harmonic. Note that for 2% third harmonic distortion the error in the reading could range from 0 to 0.687%.

## 2-43. ERRORS DUE TO GROUNDING

2-44. In the 873A there is an 0.01 uf capacitor connected from the COMMON terminal to chassis ground. If the voltage to be connected to the COMMON terminal is not at ground potential, a line cord adapter must be used to isolate the 873A chassis from line ground. (The 873AB can be switched to battery operation.) Otherwise, the 0.01 uf capacitor will become an ac load on the circuit being measured.

| Harmonic | % Distortion | % Error From True RMS* | |
|---|---|---|---|
| | | Maximum Positive | Maximum Negative |
| Any even harmonic | 0.1 | 0.000 | 0.000 |
| | 0.5 | 0.000 | 0.0001 |
| | 1.0 | 0.000 | 0.005 |
| | 2.0 | 0.000 | 0.020 |
| Third harmonic | 0.1 | 0.033 | 0.033 |
| | 0.5 | 0.167 | 0.168 |
| | 1.0 | 0.328 | 0.338 |
| | 2.0 | 0.667 | 0.687 |
| Fifth harmonic | 0.1 | 0.020 | 0.020 |
| | 0.5 | 0.099 | 0.101 |
| | 1.0 | 0.195 | 0.205 |
| | 2.0 | 0.380 | 0.420 |

*Error depends upon phase relationship between harmonic and fundamental, i.e. error can be any value between maximum positive and maximum negative, including zero.

Figure 2-6. PERCENT ERROR DUE TO HARMONIC DISTORTION

## 2-45. INTERNAL CONVERTER NOISE

2-46. When the instrument is shorted in the ac mode, the converter may produce a residual noise output of approximately 100 uv. This noise voltage will cause an insignificant error as long as ac input signals of 1 mv or larger are applied to the instrument. Figure 2-7 illustrates a typical half cycle of the signal voltage at the output of the converter amplifier. It is easily seen that the noise contributes very little to the average value of the signal and is well within the 2.7% accuracy of the instrument at 1 mv.

## 2-47. MOST SENSITIVE NULL RANGE

2-48. The most sensitive null range for each input range is labled DC ONLY, and is useful for measuring only dc voltages. Since the ac to dc converter provides a full-scale output of 1 volt, use of the last null switch position for ac measurements would require a full-scale null detector sensitivity of 100 uv. However, maximum full-scale sensitivity of the null detector is 1 mv. Consequently, switches S2, S3, and S4 are wired so that, for ac measurements, the null-detector input voltage is identical in the last two null switch positions. Usage of the last null position on ac (or on the 1 volt range for dc) yields no increase in null-detector sensitivity.

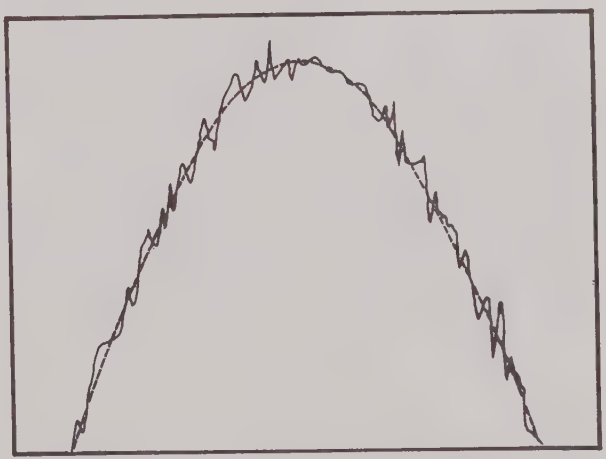


Figure 2-7. SIGNAL VOLTAGE WITH CONVERTER NOISE

# SECTION III

# THEORY OF OPERATION

## 3-1. INTRODUCTION

### 3-2. GENERAL

3-3. A block diagram of the 873A/873AB AC/DC Differential Voltmeter is given in Figure 3-1. The main circuits in the instrument are an input attenuator, a dc transistorized voltmeter (tvm), an extremely accurate 0 to 11 volt dc reference, and an ac to dc converter. The input attenuator reduces the input voltage of the 100 and 1000 volt dc ranges. The tvm uses an attenuator and a high-sensitivity null detector. A Kelvin-Varley divider is used to adjust the reference voltage from 0 to 11 volts dc. The ac to dc converter changes the unknown ac voltage into an equivalent dc voltage. Refer to the functional schematic in the back of the manual for more detail. This schematic is intended to aid in understanding the circuit theory and in troubleshooting. The signal flow is from left to right, and the components are arranged functionally.

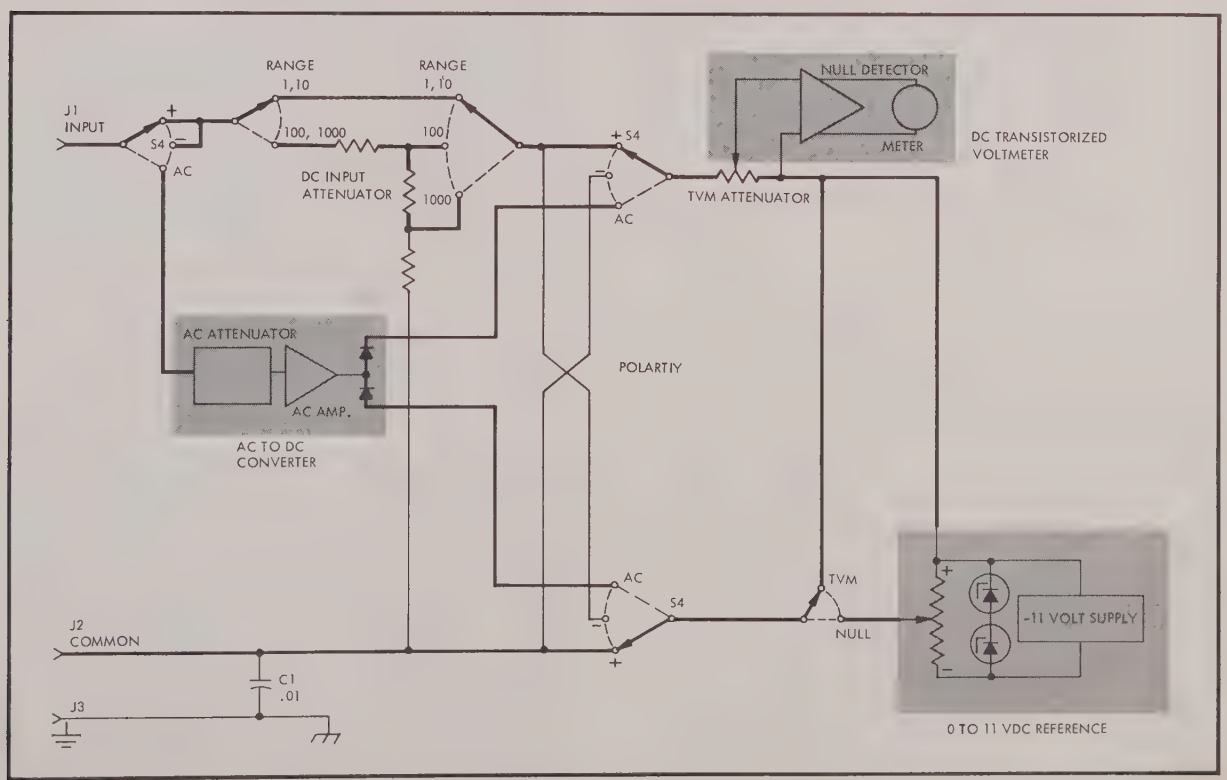



Figure 3-1. MODEL 873A AND 873AB BLOCK DIAGRAM

3-4. The overall operation of the instrument may be summarized as follows. To measure the approximate value of a dc voltage between 0 and 11 volts, the unknown voltage is connected directly across the tvm attenuator. The tvm attenuator reduces the full scale voltage in each range to 1 millivolt, which is the basic sensitivity of the null detector for full-scale meter deflection. The meter thus indicates the magnitude of the unknown voltage. To accurately measure the unknown dc voltage, it is connected across the series combination of the null detector and the 0 to 11 volt reference voltage. The reference voltage is then adjusted with the four voltage readout dials until it matches the unknown voltage as indicated by the null detector meter. The unknown voltage is then indicated by the four voltage dials. When measuring voltages between 11 and 1100 volts dc, the input attenuator divides the unknown voltage by 10 on the 100 volt range, and by 100 on the 1000 volt range. The instrument then operates essentially the same as for measurements of 0 to 11 volts. When measuring ac voltages, the unknown ac is first changed to an equivalent dc voltage in the ac to dc converter, which provides 1 volt dc output for full-scale ac input on any range. The equivalent dc voltage is then applied to the tvm attenuator, and measured the same as a dc voltage on the 1 volt dc range.

## 3-5. INPUT RESISTANCE OF INSTRUMENT

3-6. DC. For the tvm, low sensitivity, and medium low sensitivity null ranges, the input resistance of the tvm attenuator is 10 megohms (R1 through R6). For the medium high and high sensitivity null ranges, the input resistance of the tvm attenuator is 1 megohm (R3 through R6). However, this is not the input resistance of the 873A. For the 1 and 10 volt ranges, the input resistance is determined by dividing the unknown terminal voltage by the current drawn from the unknown. The current drawn from the unknown is equal to the difference between the unknown terminal voltage and the internally known voltage, divided by the resistance of the tvm attenuator. The equation for input resistance can therefore be written as:

$$R_{in} = \frac{E_u}{I_u} = \frac{E_u R_a}{|E_u - E|} = \frac{E_s (R_a + R_s)}{|E_s - E|} - R_s$$

where:

$R_{in}$ = input resistance of voltmeter

$E_u$ = $E_s - I_u R_s$ = terminal voltage of unknown

$I_u$ = current drawn from unknown

$E_s$ = source voltage of unknown

$R_s$ = source resistance of unknown

$R_a$ = input resistance of tvm attenuator

$E$ = voltage indicated by voltage readout dials

$| \ |$ = absolute value (magnitude only)

Thus, the input resistance is essentially infinite (leakage resistance across input is in the order of $10^{12}$ ohms) at null when E is equal to $E_u$ and $E_s$. For the 100 and 1000 volt range, the input attenuator is always connected across the input terminals. Thus, the input resistance is equal to the resistance of the input attenuator which is 10 megohms.

3-7. AC. The ac input impedance of the instrument is 1 megohm in parallel with 40 pf.

3-8. To provide a more complete understanding of the voltmeter, the following paragraphs describe each section of the circuit in more detail.

## 3-9. INPUT ATTENUATOR

3-10. Since the instrument contains a 0 to 11 volt reference, the unknown voltage is measured by comparing it directly to a known voltage with the aid of a null detector only on the 1 and 10 volt ranges. On the 100 and 1000 volt ranges, the input attenuator (R101 through R107) divides the unknown voltage by 10 and by 100, respectively, and this attenuated voltage is then measured the same as the 10 volt range. The input attenuator is extremely accurate and has excellent long term stability. The variable resistors R104 and R106 are used during calibration to set the correct division ratios.

## 3-11. DC TRANSISTORIZED VOLTMETER

### 3-12. GENERAL

3-13. The dc transistorized voltmeter (tvm) is composed of a tvm attenuator and a null detector. The heart of the dc tvm is the null detector in which the dc signal is modulated by a photochopper, amplified by a five stage amplifier, rectified by a transistor switch, and filtered to produce a dc output. High dc negative feedback makes the null detector relatively insensitive to gain variations in the individual transistors. The output of the null detector drives a meter with tautband suspension. The tautband eliminates the friction associated with pivot and jewel meters. Thus, any tendency for the meter pointer to stick at one point of the scale and then jump to another point is eliminated. The tvm attenuator reduces the applied voltage to 1 mv, the full-scale sensitivity of the null detector.

### 3-14. NULL-DETECTOR

3-15. The null detector is a current feedback amplifier that drives a meter. Any feedback amplifier is essentially a null seeking device. That is, it tends to make the voltage fed back to the input equal to the input voltage. In a current feedback amplifier, the feedback voltage is proportional to the output current. At the input to the 873A null detector, R201, C201, R202, and C202 form a double section low-pass filter that reduces any ac component present on the dc voltage being measured. The difference between the voltage appearing at the output of the filter and the voltage developed across feedback resistor R203 is converted to an alternating voltage by V201, a photochopper. The voltage across R203 is proportional to the current flowing in the meter. The alternating voltage created by V201 is amplified by a five-stage solid-state amplifier. The first stage is a

p-channel field effect transistor, Q201. The field effect transistor provides high input impedance and low noise. The next four stages consist of common-emitter amplification, with overall feedback from Q205 to Q202. A transistor switch, Q209, is gated in synchronization with V201. During the "off" portion of the photochopper cycle, the output of the amplifier is clamped to null detector common potential by Q209. During the "on" portion of the photochopper cycle, the output of the amplifier is filtered by R230 and C214 to provide a dc current for the meter. A portion of the current that flows through the meter is shunted back to the 200 ohm feedback resistor R203, thus completing the feedback loop. The gain of the null detector can be adjusted by means of R231 in the feedback network. The null detector has a basic sensitivity of 1 millivolt. However, to compensate for the loading effect of the tvm attenuator on the input attenuator, the full-scale sensitivity of the null detector is increased for the 100 and 1000 volt dc ranges according to the table below.

| RANGE | NULL POSITION | | | | |
|---|---|---|---|---|---|
| | TVM | LO | Med Lo | Med Hi | Hi |
| 100 V | 910uv | 910uv | 910uv | 526uv | 526uv |
| 1000 V | 1mv | 1mv | 1mv | 910uv | 910uv |

3-16. TVM ATTENUATOR

3-17. In the tvm mode, one position on the tvm attenuator selected by range switch section S2G provides the necessary reduction of the 1 volt range for proper null detector input. Another position on the tvm attenuator is used for the 10, 100, and 1000 volt ranges because the input attenuator divides the input signal so as to reduce the 100 and 1000 volt ranges to the equivalent of the 10 volt range. In the null mode, the voltage difference (unknown voltage, or unknown voltage divided down, minus the reference voltage) is reduced as necessary by positions on the tvm attenuator selected by null switch sections S3H, S3G, and S3E to provide the basic null detector input of 1 millivolt.

3-18. PHOTOCHOPPER DRIVE CIRCUIT

3-19. Drive for the photochopper is obtained from a free-running multivibrator, Q206 and Q207. During the portion of the cycle that Q207 is on, Q208 is also on, which provides current through T201. When Q208 turns off, the flyback voltage of T201 illuminates neon lamp DS202. Transistor Q209 is driven in synchronization with DS202 through C213, transistor Q209 being off when DS202 is on. Resistor R218 is used to adjust the chopper frequency to 84 Hz, and resistor R219 is used to adjust the duty cycle of DS202. Resistor R227 is used to electrically zero the null detector.

3-20. INFLUENCE OF AC COMPONENTS

3-21. The only ac voltage component that will reduce the accuracy of dc measurements of the 873A is one that either saturates the null detector or that beats with the chopper frequency. Since the voltage required for saturation is greater than that required for beating, the null detector is most sensitive to an ac component with a frequency that is a submultiple or a low multiple of the chopper frequency. However, this is easy to detect because the meter will oscillate at the difference frequency. The low pass filter at the input of the chopper-amplifier will attenuate any ac component. The magnitude of the ac voltage appearing at the output of the filter depends on both its amplitude and frequency before filtering. For all practical purposes, one should never encounter any trouble above a hundred cycles. If ac components that affect accuracy are ever encountered, additional filtering as outlined in the operating instructions will eliminate the problem.

3-22. RECORDER OUTPUT

3-23. The recorder output is provided by R236, R7, and R237. Recorder output AMP ADJ control R7 provides for adjusting the recorder output voltage up to a maximum of at least 20 millivolts at full-scale deflection (1.0). The voltage at the RECORDER OUTPUT terminals is proportional to the meter deflection.

## 3-24. 0 TO 11 VOLT REFERENCE

3-25. GENERAL

3-26. In making differential voltage measurements between 0 and 11 volts, an internal reference voltage is nulled or matched against the unknown voltage. An extremely accurate reference voltage is therefore required. This is obtained from the 11 volt reference. The 0 to 11 volt reference is composed of a well regulated -16.5 volt power supply, a range divider, and a four decade Kelvin-Varley divider. The range divider reduces the voltage from a pair of Zener diodes in the -16.5 volt reference supply to 11 volts for the 10, 100, and 1000 volt ranges, and to 1.1 volts for the 1 volt range, before the reference voltage is applied to the Kelvin-Varley divider. The Kelvin-Varley divides the input reference voltage into 110,000 equal increments, thus providing an extremely accurate reference voltage.

3-27. -16.5 VOLT POWER SUPPLY

3-28. The -16.5 volt power supply uses diode CR101 and filter network R108-C101 to supply unregulated dc voltage to series pass transistor Q101. In the Model 873AB, unregulated dc voltage is supplied directly from batteries BT1 in the BAT CHECK and BAT OPR modes. The voltage is regulated by comparing a sample of the output voltage tapped off divider string R109, R110, and R111 with the voltage from Zener reference diodes CR103 and CR104 in a differential amplifier, Q102 and Q103. The output of the differential amplifier is amplified by Q104, which drives the base of series pass transistor Q101. The voltage drop across the series pass transistor, Q101, is continuously adjusted so as to maintain the two input voltages of the differential amplifier at the same level, and thus maintain the output voltage at a constant value. The -16.5 volt output is used to provide operating voltages for the null detector and for R117, which supplies a constant current to reference diodes CR103 and CR104. The voltage across the two Zener diodes may be between 12.0 and 13.0 volts, and has a stability better than 50 ppm per year and an overall temperature coefficient less than 5 ppm per °C.

# SECTION IV

# MAINTENANCE

## 4-1. INTRODUCTION

4-2. Maintenance of the 873A series DC Differential Voltmeter should consist primarily of periodic cleaning and calibration. However, to determine if the instrument is within specifications, it is recommended that its performance be checked just before calibration by using the performance tests given in this section. Information on corrective maintenance is also included.

## 4-3. TEST EQUIPMENT

4-4. Figure 4-1 lists the recommended equipment and specifications required for performance testing, calibration, and corrective maintenance. If the recommended equipment is not available, other equipment which meets the required specifications may be used.

## 4-5. PERIODIC MAINTENANCE

4-6. Periodic maintenance consists primarily of occasional cleaning to remove dust, grease, and other contamination. Since the voltmeter is completely enclosed, the need for cleaning is reduced. Special care has been taken to prevent leakage across critical switch wafers, areas of some printed circuit boards, and from the printed circuit boards to chassis ground. The power, range, null, polarity, and all voltage readout switches are vacuum impregnated with silicone oil. These switches are also isolated from the chassis with Lexan spacers. The printed circuit boards are coated with a moisture sealant, and are isolated from chassis ground by means of polyethelene grommets.

4-7. To clean the instrument, proceed as follows:

***CAUTION!***

Avoid touching the polyethelene grommets. Contamination can cause excessive electrical leakage and/or voltaic effects.

a. Remove accumulations of dust with low-pressure, clean, dry air. Pay particular attention to the input binding posts, binding post wiring, switches, and polyethelene grommets which insulate the printed circuit boards from the chassis.

b. Clean polyethelene grommets, binding posts, and front panel with anhydrous denatured ethyl alcohol or an aerosol can of Freon TF Degreaser (Miller-Stephenson Chemical Co., Inc.) and, when necessary, a clean cloth or cotton swab.

***CAUTION!***

Do not use Metriclene, acetone, lacquer thinner, or any ketone, since they will react with the Lexan switch rotor. Also, be careful not to saturate the switch contacts, which have been lubricated for life.

c. When necessary, clean all exposed dielectric surfaces of switches with denatured alcohol, using a small, stiff-bristled brush which has been wrapped with a clean cloth to prevent saturating the switch contacts.

d. After cleaning, recoat exposed switch insulating material with silicon oil having a viscosity between 5 and 20 centistokes. This prevents leakage due to moisture on these surfaces.

## 4-8. PERFORMANCE TESTING

### 4-9. GENERAL

4-10. The following tests are designed to check the instruments performance against the specifications. The tests may be used as a routine maintenance procedure, and as an incoming inspection procedure. It is recommended that these performance checks be done just before calibration of the instrument. When used in this way, the performance tests provide a valuable case history on the characteristics of each instrument. Just prior to calibration, the instrument should be within specifications: if not, troubleshooting should be performed to eliminate the cause of the error before calibrating the instrument. Localizing the problem to a particular area of the instrument may be done by an analysis of the performance test results.

### 4-11. NULL DETECTOR SENSITIVITY TEST

4-12. The null detector is checked in this procedure by using the instruments internal reference supply and Kelvin-Varley divider. If the instrument fails to pass

| RECOMMENDED EQUIPMENT | SPECIFICATIONS REQUIRED | USED FOR |
|---|---|---|
| VTVM, RCA Voltohmyst, or equivalent | Accuracy: ±3% dc<br>±5% ac<br><br>Input Impedance: 10M Ω, dc<br>1M Ω, 5 pf, ac | TROUBLESHOOTING<br>ELECTRONIC ADJUSTMENTS |
| Autotransformer, General Radio Model W5MT3 (Model W5HMT for 230 volt instruments), or equivalent. | 103 to 127 volts<br>(207 to 253 volts for 230 volt instruments) | TROUBLESHOOTING |
| DC Differential Voltmeter, Fluke Model 821A, or equivalent | Range: 500V, approximately<br>Accuracy: ±0.01%<br>Null Sensitivity: At least 1mv.<br>Externally-adjustable reference voltage.<br>20ppm accuracy of Kelvin-Varley divider. | TROUBLESHOOTING |
| Standard Cell | Accuracy: ±.0005%<br>Stability: ±.0004% | TROUBLESHOOTING |
| Oscilloscope, Hewlett-Packard Model 120B, or equivalent | Vertical sensitivity: 20 V/cm<br>Sweep speed: 1 ms/cm, minimum | ELECTRONIC ADJUSTMENTS |
| Voltage Calibrator, Fluke Model 332A, or equivalent | Range: 0 to 1000 vdc<br>Accuracy: ±0.005%, minimum<br>(332A is ±0.003%) | PERFORMANCE TESTING<br>CALIBRATION |
| Krohn-Hite Model LDS-1500 Oscillator | Range: 1 to 1000 vac<br>400 Hz, 10 kHz, and 20 kHz<br>Accuracy: ±0.04%, less than 0.1% harmonic distortion | CALIBRATION |
| Fluke Model 540B Transfer Standard with A54-1 plug-in | Transfer accuracy: ±0.02%<br>Range: 0 to 1000 volts | CALIBRATION |
| Fluke Model 910A RMS Voltmeter | RMS measurement of non-sinusoidal waveforms at 200 uv level. | ELECTRONIC ADJUSTMENTS. |

Figure 4-1. TEST EQUIPMENT REQUIRED

this test, it may be due to a faulty reference supply or Kelvin-Varley divider. In this case, the measurement of an appropriate voltage in the tvm mode will indicate if the null detector is operating properly. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.
b. Check meter for electrical and mechanical zero according to paragraph 4-56.
c. Short INPUT post to COMMON post, and set polarity switch to + (positive).
d. Set switches on voltmeter as shown in Figure 4-2. The meter should indicate within 1-1/2 small scale divisions (±3% of null range) of the value shown in Figure 4-2.
e. Remove the short between INPUT and COMMON posts.

## 4-13. DIFFERENTIAL MEASUREMENT TEST

4-14. The following procedure checks the dc accuracy of the instrument with full input on each range and also with each voltage readout dial set to 1, 2, 3, 4, 5, 6, 7, 8, and 9 on the 10 volt range. This method checks the accuracy with a minimum number of measurements. Proceed as follows:

a. Set meter to zero with mechanical zero control, if necessary.
b. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup to equilibrium temperature (about 5 minutes).
c. Connect the 332A Voltage Calibrator, or equivalent, to the INPUT and COMMON binding posts of the voltmeter. Connect voltmeter COMMON post to line ground. The voltage source must provide 0 to 1000 volts dc, with a minimum accuracy of ±0.005% (332A is ±0.003%).

| VOLTMETER SWITCH SETTINGS | | | |
|---|---|---|---|
| RANGE | NULL | VOLTAGE READOUT DIALS | METER INDICATION |
| 10 | 1.0 | 1. 0 0 00 | -1.0 |
| 10 | .1 | 0. 1 0 00 | -1.0 |
| 10 | .01 | 0. 0 1 00 | -1.0 |
| 10 | .001 | 0. 0 0 10 | -1.0 |
| 1 | .1 | .1 0 0 00 | -1.0 |
| 1 | .01 | .0 1 0 00 | -1.0 |
| 1 | .001 | .0 0 1 00 | -1.0 |
| 100 | 10 | 1 0.0 00 | -1.0 |
| 100 | 1 | 0 1.0 00 | -1.0 |
| 100 | .1 | 0 0.1 00 | -1.0 |
| 100 | .01 | 0 0.0 10 | -1.0 |
| 1000 | 100 | 1 0 0.00 | -1.0 |
| 1000 | 10 | 0 1 0.00 | -1.0 |
| 1000 | 1 | 0 0 1.00 | -1.0 |
| 1000 | .1 | 0 0 0.10 | -1.0 |
| 10 | 1 | 0. 1 0 00 | -0.1 |
| 10 | 1 | 0. 2 0 00 | -0.2 |
| 10 | 1 | 0. 3 0 00 | -0.3 |
| 10 | 1 | 0. 4 0 00 | -0.4 |
| 10 | 1 | 0. 5 0 00 | -0.5 |
| 10 | 1 | 0. 6 0 00 | -0.6 |
| 10 | 1 | 0. 7 0 00 | -0.7 |
| 10 | 1 | 0. 8 0 00 | -0.8 |
| 10 | 1 | 0. 9 0 00 | -0.9 |
| 10 | 1 | 1. 0 0 00 | -1.0 |
| 10 | 1 | 1. 1 0 00 | -1.1 |

Figure 4-2. SETTINGS FOR NULL DETECTOR CHECK

d. Set NULL switch to 0.1, and set voltage readout dials to 1.00000.

e. Set RANGE switch to 1.

f. Set 332A for 1.00000 volts dc output.

g. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between .99969 and 1.00031.

h. Set RANGE switch to 10, NULL switch to 1, and voltage readout dials to 10.0000.

i. Set 332A for 10.0000 volts dc output.

j. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between 9.9969 and 10.0031.

k. Set RANGE switch to 100, NULL switch to 10, and voltage readout dials to 100.000.

l. Set 332A for 100.000 volts dc output.

m. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between 99.969 and 100.031.

n. Set RANGE switch to 1000, NULL switch to 100, and voltage readout dials to 1000.00.

o. Set 332A for 1000.00 volts dc output.

p. Adjust voltage readout dials for zero meter deflection in successively more sensitive null ranges. Final voltage readout dial setting should be between 999.69 and 1000.31.

q. Set RANGE switch to 10, and set NULL switch to .001.

r. Set 332A to output voltages listed in Figure 4-3. Set voltage readout dials on voltmeter as indicated for the applied voltage, and adjust the voltage readout dials for a null on the 873A meter. Final voltage readout dial settings should be within the values listed in Figure 4-3.

| 332A OUTPUT VOLTAGE | INITIAL 873A VOLTAGE READOUT DIAL SETTING | FINAL 873A VOLTAGE READOUT DIAL SETTING |
|---|---|---|
| 1.111111 | 1.1111 | 1.1108 to 1.1114 |
| 2.222222 | 2.2222 | 2.2216 to 2.2228 |
| 3.333333 | 3.3333 | 3.3324 to 3.3342 |
| 4.444444 | 4.4444 | 4.4431 to 4.4457 |
| 5.555555 | 5.5555 | 5.5539 to 5.5571 |
| 6.666666 | 6.6666 | 6.6647 to 6.6685 |
| 7.777777 | 7.7777 | 7.7754 to 7.7800 |
| 8.888888 | 8.8888 | 8.8861 to 8.8915 |
| 9.999999 | 9.9999 | 9.9970 to 10.0028 |

Figure 4-3. VOLTAGE READOUT DIAL LIMITS

## 4-15. AC TO DC CONVERTER TEST

4-16. The following procedure checks the ac accuracy of the instrument at a specific frequency, assuming correct operation of the dc portions of the instrument. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.

b. Refer to Figure 4-4. Connect and adjust the necessary equipment to provide 10 volts ac ±0.04% at 10 kHz.

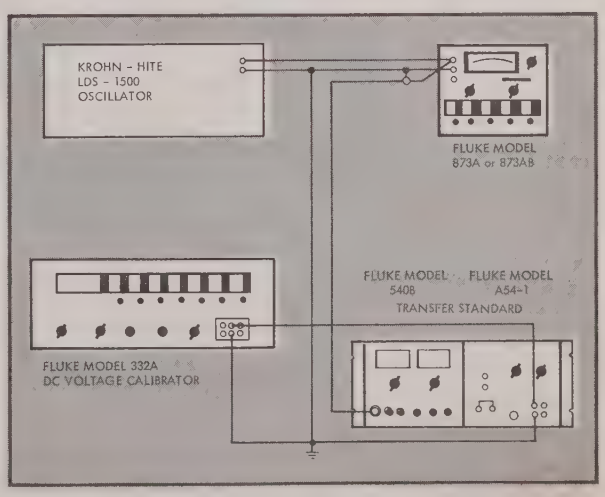



Figure 4-4. AC CALIBRATION SETUP

c. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 10 |
| NULL | .1 |
| polarity | AC |
| voltage readout dials | 10.0000 |

d. Apply 10 volts at 10 kHz between INPUT and COMMON posts. Voltmeter should indicate within ±2.5 major divisions of null: if not, the ac to dc converter is out of tolerance, assuming correct operation of the dc portions of the instrument.

## 4-17. CALIBRATION

### 4-18. GENERAL

4-19. The calibration procedure is divided into two main parts: calibration of the dc differential voltmeter, and calibration of the ac to dc converter. The dc differential voltmeter portion of the instrument must be within specifications before calibration of the ac to dc converter. The 873A may be calibrated as often as deemed necessary; however, it is recommended that the dc differential voltmeter be calibrated every 6 months, and the ac to dc converter be calibrated every 2 months. Calibration should be performed under typical laboratory conditions of 72.5 (±2.5)° F in a draft-free area. Line voltage should be 115 (±2) volts, or 230 (±4) volts for 230 volt instruments. The equipment recommended and specifications required are given in Figure 4-1. All calibration controls are identified by decals inside the instrument.

### 4-20. CALIBRATION OF DC DIFFERENTIAL VOLTMETER

4-21. DC differential voltmeter calibration is divided into six parts: Preliminary Setup, Null Detector Calibration, 10 Volt Range Calibration, 1 Volt Range Calibration, 100 Volt Range Calibration, and 1000 Volt Range Calibration. Calibration is usually performed in the given sequence.

### 4-22. PRELIMINARY SETUP

a. Set meter to zero according to paragraph 4-56, if necessary.
b. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.
c. Connect the 332A Voltage Calibrator, or equivalent, to the INPUT and COMMON binding posts of the voltmeter. Connect voltmeter COMMON post to line ground. The voltage source must provide dc voltages of 0 to 1000 volts, with an accuracy of at least ±0.005% (332A is ±0.003%).

### 4-23. NULL DETECTOR CALIBRATION

a. Short INPUT post to COMMON post.
b. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 1 |
| NULL | .001 |
| voltage readout dials | .00100 |
| polarity | + (positive) |

c. Adjust 1 mv gain control R231 for full-scale meter deflection to the left (-1.0), observed when the right side panel is replaced.
d. Remove the short between the INPUT and COMMON posts.

### 4-24. 10 VOLT RANGE CALIBRATION

**Note!** The 10 volt range must be calibrated before attempting calibration of the 1, 100, or 1000 volt ranges. To prevent possible error due to leakage, use an insulated screwdriver to adjust R119, R121, R104, and R106.

a. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 10 |
| NULL | 1.0 |
| voltage readout dials | 10.0000 |
| polarity | + (positive) |

b. Set 332A for 10.0000 volts output.
c. Adjust R119 for zero meter deflection in successively more sensitive null ranges. Resistor R111 may be adjusted if there is insufficient range in R119.

### 4-25. 1 VOLT RANGE CALIBRATION

a. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 1 |
| NULL | .1 |
| voltage readout dials | 1.00000 |
| polarity | + (positive) |

b. Set 332A for 1.00000 volt output.
c. Adjust R121 for zero meter deflection in successively more sensitive null ranges. The right side panel must be on the instrument when making this adjustment.

### 4-26. 100 VOLT RANGE CALIBRATION

a. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 100 |
| NULL | 10 |
| voltage readout dials | 100.000 |
| polarity | + (positive) |

b. Set 332A for 100.000 volts output.
c. Adjust input attenuator R104 for zero meter deflection in successively more sensitive null ranges.

### 4-27. 1000 VOLT RANGE CALIBRATION

a. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 1000 |
| NULL | 100 |
| voltage readout dials | 1000.00 |
| polarity | + (positive) |

b. Set 332A for 1000.00 volts output.
c. Adjust input attenuator R106 for zero meter deflection in successively more sensitive null ranges.

## 4-28. CALIBRATION OF AC TO DC CONVERTER

4-29. The dc differential voltmeter section of the instrument must be within specifications before the ac to dc converter can be accurately calibrated. The ac to dc converter must be calibrated in the following sequence.

## 4-30. PRELIMINARY CALIBRATION PROCEDURE

a. Zero instrument according to paragraph 4-56, if necessary.
b. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 1 |
| NULL | TVM |
| polarity | AC |
| voltage readout dials | 1.00000 |

c. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow voltmeter to warmup for about 5 minutes.
d. Connect and adjust the necessary equipment to provide 100, 10, and 1 volts at 400 Hz and at 20 kHz with an amplitude accuracy of 0.04%: and 500 volts at 400 Hz and 10 kHz with an amplitude accuracy of 0.04%. All voltages must have less than 0.1% total harmonic distortion. The required voltages can be obtained as follows:
e. Connect equipment as shown in Figure 4-4. Turn on all equipment and allow it to warmup for about 1/2 hour. Set 332A output voltage to the rms value of the required ac voltage. Apply output of 332A to 540B and null galvanometer by adjusting 540B internal reference supply. Apply output of ac oscillator to 540B and null galvanometer by adjusting ac oscillator voltage. The oscillator output now equals the required ac voltage.
f. Remove top cover of voltmeter.

## 4-31. GAIN ADJUSTMENT AT 1 VAC

a. Apply 1 volt at 400 Hz between INPUT and COMMON posts.
b. Set NULL switch to .001.
c. Adjust R503 until meter needle is within ±200 microvolts (2 major divisions) of null when top cover is replaced.

## 4-32. HIGH FREQUENCY ADJUSTMENT AT 1 VAC

a. Apply 1 volt at 20 kHz between INPUT and COMMON posts.
b. Adjust C502 until meter needle is within ±200 microvolts (2 major divisions) of null when top cover is replaced.

## 4-33. ATTENUATOR ADJUSTMENT AT 10 VAC

a. Set RANGE switch to 10, and set NULL switch to TVM.
b. Apply 10 volts at 400 Hz between INPUT and COMMON posts.
c. Set NULL switch to .01.
d. Adjust R403 until meter needle is within ±2 millivolts (2 major divisions) of null when top cover is replaced. Note that 10, 100, and 1000 volt attenuator controls and 10, 100, and 1000 volt high frequency adjust controls are located from left to right, respectively, on bracket next to converter board.

## 4-34. HIGH FREQUENCY ADJUSTMENT AT 10 VAC

a. Apply 10 volts at 20 kHz between INPUT and COMMON posts.
b. Adjust C402 until meter needle is within ±2 millivolts (2 major divisions) of null when the top cover is replaced.

## 4-35. ATTENUATOR ADJUSTMENT AT 100 VAC

a. Set RANGE switch to 100 and set NULL switch to TVM.
b. Apply 100 volts at 400 Hz between INPUT and COMMON posts.
c. Set NULL switch to .1.
d. Adjust R406 until meter needle is within ±20 millivolts (2 major divisions) of null when the top cover is replaced.

## 4-36. HIGH FREQUENCY ADJUSTMENT AT 100 VAC

a. Apply 100 volts at 20 kHz between INPUT and COMMON posts.
b. Adjust C404 until meter needle is within ±20 millivolts (2 major divisions) of null when the top cover is replaced.

## 4-37. ATTENUATOR ADJUSTMENT FOR 1000 VAC

a. Set RANGE switch to 1000 and set NULL switch to 1.
b. Set voltage readout dials to 500.00.
c. Apply 500 volts at 400 Hz between INPUT and COMMON posts.
d. Adjust R409 until meter needle is within ±100 millivolts (1 major division) of null when the top cover is replaced.

*Note!*

If preferred, 1000 volts at 400 Hz may be used by adjusting R410 until meter needle is within ±200 millivolts (2 major divisions) of null with 1000 volts applied.

## 4-38. HIGH FREQUENCY ADJUSTMENT FOR 1000 VAC

a. Apply 500 volts at 10 kHz between INPUT and COMMON posts.
b. Adjust C405 until meter needle is within ±100 millivolts (1 major division) of null when the top cover is replaced.

*Note!*

If preferred, 1000 volts at 10 kHz may be used by adjusting C405 until meter needle is within ±200 millivolts (2 major divisions) of null with 1000 volts applied.

## 4-39. CORRECTIVE MAINTENANCE

### 4-40. GENERAL

4-41. Since the 873A AC/DC Differential Voltmeter is a completely transistorized instrument, the possibility of component failure is reduced. Under normal circumstances, the only thing that will interfere with the operation of the instrument is the need for calibration. However, if the instrument does not perform correctly before or after calibration, the technician may use the information given here as a guide for locating and correcting the source of trouble. All equipment required for maintaining the instrument is listed in Figure 4-1.

### 4-42. TROUBLESHOOTING

4-43. The purpose of troubleshooting is to quickly and accurately correct the cause of any abnormal condition. Thus, servicing should begin with an attempt to localize the general area of trouble. By performing a complete performance check as outlined in paragraph 4-8, the trouble may be isolated to the null detector, reference supply, Kelvin-Varley divider, input attenuator, or ac to dc converter. To assist in localizing some of the more common troubles that may occur, the causes and remedies for a number of malfunctions are listed in the troubleshooting chart, Figure 4-5. However, an understanding of the circuit theory and frequent reference to the schematic diagram is the best way to locate the cause of any trouble.

4-44. VISUAL INSPECTION. Trouble can sometimes be found by a thorough visual inspection. Look for:

a. Accumulations of dirt, dust, moisture, or grease. Remove contamination as outlined in periodic maintenance, paragraph 4-7.

b. Scorched or burned parts. Damage of this type is usually due to a defective component. Determine cause of damage before replacing overheated part.

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Drift of reference supply, evidenced by meter needle drift | R109, R110, R114, R115, R117, R118, R120, or R122 changing value with temperature change. | Locate faulty resistor by heating with a soldering iron held near resistor, while making a standard cell measurement. Meter drift will indicate faulty resistor. |
| | Faulty Zener diode | Monitor voltage across Zener diode pair. If Zener voltage drifts, replace Zener diodes, and R118. |
| | Q101, Q102, Q103, or Q104 defective. | Check, and replace if necessary. |
| Meter rattle or drift | Dirty or defective FET, Q201. | Clean input to Q201. Vary operating point slightly with R209, or replace. |
| | Dirty lucite rod | Clean |
| | Faulty DS202 | Check by replacement |
| | Faulty C206 | Check by replacement |
| | Moisture, dirt, or other contamination on printed circuit boards, or switches | Clean instrument according to paragraph 4-7. |
| | Faulty Zener diode | Monitor voltage across Zener pair. Replace if rattle exceeds 50 ppm peak-to-peak. |
| Measurements are out of tolerance on every range except at full scale | One of the Kelvin-Varley resistors is out of tolerance | Check accuracy of Kelvin-Varley divider according to paragraph 4-50. |
| | Leakage from Null Detector to ground | Clean instrument according to paragraph 4-7. |
| Meter beats with voltage being measured. | Chopper drive circuit out of adjustment. | Adjust photochopper drive frequency according to paragraph 4-54. |

Figure 4-5. TROUBLESHOOTING CHART

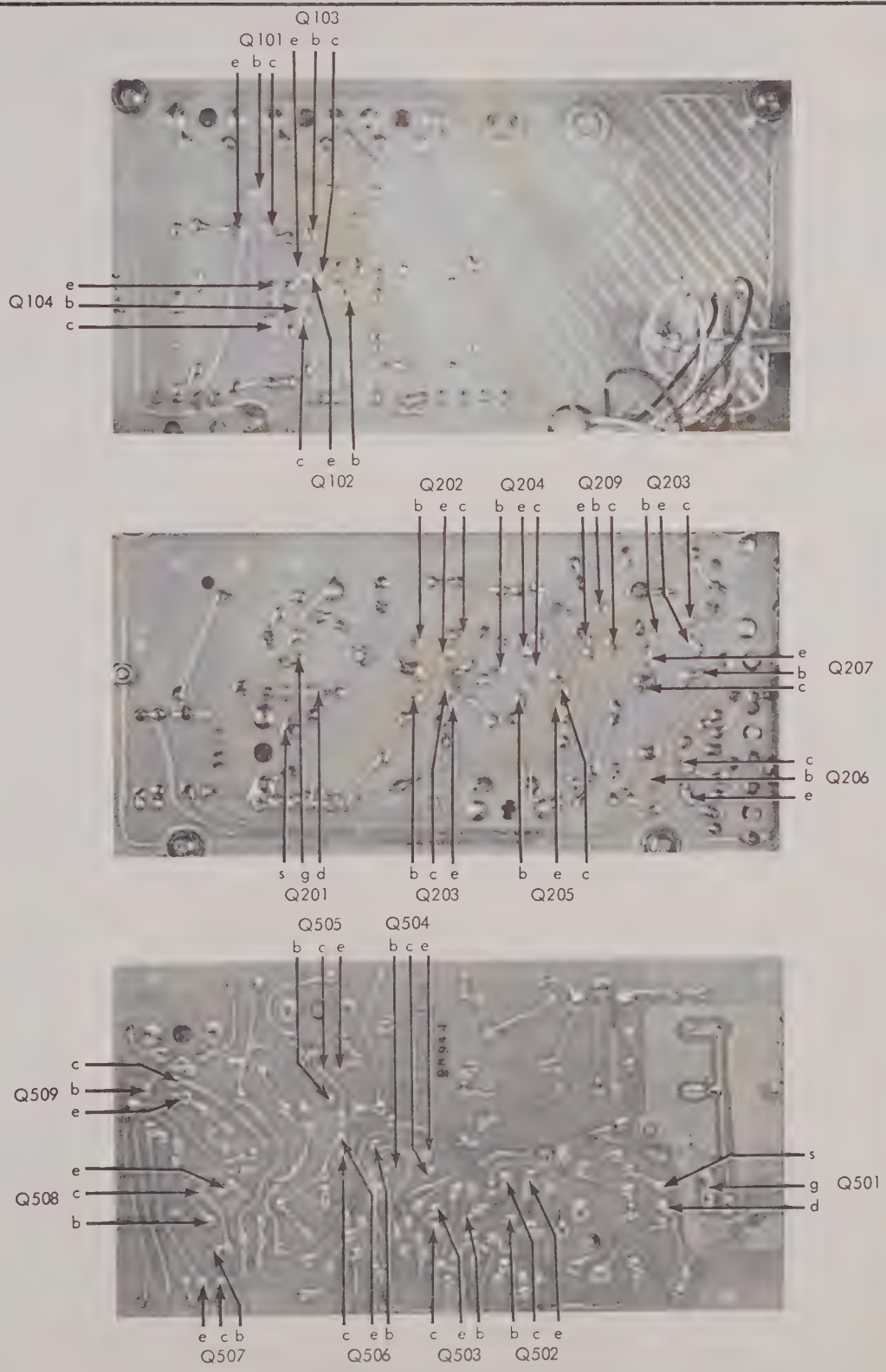



Figure 4-6. LOCATION OF TRANSISTOR TERMINALS

**CAUTION!**

Avoid touching the polyethelene grommets. Contamination can cause electrical leakage and/or voltaic effects.

c. Cracks, cuts, and other damage to polyethelene grommets. Replace grommets, using a plastic bag over the hand to prevent contamination.
d. Input divider resistors (R101, R102, R103, R105, and R107) touching the printed circuit board. When these resistors touch the circuit board, leakage paths are created which can result in error.
e. Loose or intermittent connections.

4-45. VOLTAGE LEVEL CHECKING. When the trouble has been localized to a stage, the defective part may be isolated by voltage level measurements at the transistor terminals. Transistor terminals are identified in Figure 4-6. When making measurements on printed circuit boards, use a sharp probe and press firmly while rotating the probe to break through the insulating coating. Measurements that differ widely from those listed in the transistor voltage chart, Figure 4-7, can be used to isolate the defective part in most cases.

**CAUTION!**

When measuring pin voltages, it is recommended that care be used to prevent momentary short circuits which could damage transistors.

4-46. TROUBLESHOOTING CHECKS. The following troubleshooting checks list several checks that can be performed on the instrument. The most probable cause of an abnormal condition is also given.

| TRANSISTOR | EMITTER (vdc) | BASE (vdc) | COLLECTOR (vdc) |
|---|---|---|---|
| Q101 | -27.2 ① | -26.2 | -16.6 ② |
| Q102 | -13.4 | -13.0 | - 6.9 |
| Q103 | -13.4 | -13.0 | 0 |
| Q104 | - 6.3 | - 6.9 | -26.2 |
| Q201 | 0 to - 5.0 (SOURCE) | 0 (GATE) | -5 to -11 (DRAIN) |
| Q202 | 0 | - .5 | - .6 |
| Q203 | 0 | - .6 | - 1.9 |
| Q204 | - 1.6 | - 1.9 | - 3.0 |
| Q205 | - 3.0 | - 3.6 | - 8.3 |
| Q206 | -16.6 | -21.2 | - 6.6 |
| Q207 | -16.6 | -18.5 | -11.7 |
| Q208 | -16.6 | -16.6 | - 3.6 |
| Q209 | 0 | + 2.0 | 0 |
| Q501 | 6.9 (SOURCE) | 5.1 (GATE) | 11.1 (DRAIN) |
| Q502 | 0 | 0.7 | 3.1 |
| Q503 | 2.4 | 3.1 | 9.6 |
| Q504 | 0 | .7 | 3.7 |
| Q505 | 10.8 | 11.4 | 18.1 |
| Q506 | 2.9 | 3.7 | 9.1 |
| Q507 | 35.4 ③ | 34.9 | 18.1 ④ |
| Q508 | 1.8 | 2.2 | 34.9 |
| Q509 | 6.5 | 6.0 | 2.2 |

The above operating voltage levels are measured under the following conditions: (a) line voltage at 115/230 vac, 50 to 440 Hz; (b) all voltages measured with a 3%, 10 megohm voltmeter from specified terminal to common of circuit being measured. The COMMON post is reference supply-null detector common when in TVM mode or when in a NULL mode with all voltage dials set to 0 and polarity switch set to +; the COMMON post is ac to dc converter common when polarity switch is set to AC. (c) some voltages may vary as much as 20%, however, bias voltages (difference between emitter and base voltages) should remain approximately the same. NOTES: ① Emitter of Q101 should be between -26 and -35 vdc for 115/230 vac line operation, between -19.5 and -21.0 vdc for BAT OPR (873AB only), and not less than -23.5 vdc for BAT CHG (873AB only) as measured with a VTVM. ② Collector of Q101 should be between -15.8 and -17.9 vdc as measured with a VTVM. ③ Emitter of Q507 should be between +26 and +35 vdc for 115/230 vac line operation, between +19.5 and +21 vdc for BAT OPR (873AB only), and not less than +23.5 vdc for BAT CHG (873AB only) as measured with a VTVM. ④ Collector of Q507 should be between +16.5 and +19.5 vdc as measured with a VTVM. To prevent damaging the transistor, use care when measuring near Q507.

Figure 4-7. TRANSISTOR VOLTAGE CHART

4-47. Meter Rattle Check. If the meter needle appears to rattle excessively, perform the following check:

a. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 1 |
| NULL | .001 |
| voltage readout dials | zero |
| polarity | + (positive) |

b. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow a warmup period of 5 minutes.
c. Short INPUT post to COMMON post. Random excursions of meter needle should be less than 1/4 small division peak-to-peak. If rattle is excessive, check field-effect transistor Q201 by replacement, or by slightly varying the operating point of Q201 with R209.

4-48. Reference Voltage Regulation. If regulation of the reference voltage is suspected of being faulty, perform the following check:

a. Connect an autotransformer to line power. A high-quality ground must be provided for the autotransformer.
b. Connect 873A line cord to output of autotransformer.
c. Set POWER switch to LINE OPR with 873AB, or to ON with 873A, and allow a warmup period of 5 minutes.
d. Set autotransformer to 103 volts (207 volts when voltmeter is wired for 230 volt operation) as measured with a VTVM.
e. Set NULL switch to TVM.
f. Set polarity switch to + (positive).
g. Connect a differential voltmeter between the COMMON post and the base of Q103, and record the voltage measured.
h. Set the autotransformer to 127 volts (253 volts when voltmeter is wired for 230 volt operation). Voltage indication of differential voltmeter should change by less than 200 uv from step g. If regulation is poor, it is probably due to excessive load current from the reference supply to the null detector.

4-49. Common Mode Measurement Check. If the instrument is suspected of making incorrect measurements in the presence of common mode voltages, perform the following check:

a. Measure the voltage of a standard cell, using the 1 volt range and positive polarity. The standard cell must be floating.
b. Connect 500 vdc from chassis ground post to COMMON post, and wait for 3 minutes.
c. Measure standard cell voltage. If the two measurements differ by more than 50 microvolts, there is excess electrical leakage to ground. Clean instrument according to paragraph 4-5.

4-50. Kelvin-Varley Divider Check. The Kelvin-Varley divider check requires a connection to the Kelvin-Varley divider inside the instrument. Proceed as follows:

a. Remove bottom panel.
b. Locate input-output common wire. This is the black wire connected to the bottom of S301 (voltage dial A).
c. Jumper from the input-output common wire located in step b. to the 821A common post.
d. Connect the INPUT post to the 821A input post.
e. Set 873A switches as follows:

| | |
|---|---|
| RANGE | 10 |
| NULL | Any null range |
| polarity | - (negative) |
| voltage readout dials | 10.0000 |

f. Set 821A polarity switch to - (negative).
g. Set 821A voltage readout dials to 9.9910. With operate-calibrate control set to operate, adjust 821A calibrate control for zero meter deflection in most sensitive null range.
h. Set the 873A and 821A readout dials to the values given in Figure 4-8. The panel meter of the 821A should indicate within the maximum deviation column of Figure 4-8 for each step. If the Kelvin-Varley divider is out of tolerance, a resistor is defective and must be replaced.

## 4-51. ELECTRONIC ADJUSTMENTS

4-52. The following electronic adjustments may occasionally be required.

4-53. ADJUSTMENT OF -16.5 VOLT SUPPLY. Resistor R111 usually requires adjustment when a part is replaced in the -16.5 volt power supply. Resistor R111 is adjusted, if necessary, by performing the 10 volt and 1 volt range calibration (paragraphs 4-24 and 4-25).

4-54. PHOTOCHOPPER FREQUENCY ADJUSTMENT. The photochopper frequency should be adjusted if a part is replaced in the drive circuit, if there is difficulty in zeroing the meter, or if line operation causes the meter to beat with the voltage being measured. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB or to ON with 873A.
b. Set NULL switch to TVM, and set polarity switch to + (positive).
c. Connect oscilloscope between COMMON post and collector of Q208 (test point 1).
d. Set oscilloscope controls as follows:

| | |
|---|---|
| Vertical sensitivity | 20v/cm |
| Trigger mode | Automatic |
| Trigger slope | "Int (+)" |
| Time | 2 milliseconds/cm |

e. Adjust R218 for a 12 millisecond drive period.
f. Adjust R219 for a duty period of 4 milliseconds.
g. Since R218 and R219 interact slightly, repeat steps e. and f.

4-55. BIAS ADJUSTMENT OF FIELD-EFFECT TRANSISTORS. The bias of field-effect transistors Q201 and Q501 may require adjustment if the transistors, or a component in their respective source-drain circuits is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A.
b. Set NULL switch to TVM.

| 871A Voltage Dial Settings | 821A Voltage Dial Settings | Maximum Deviation ± microvolts for 11 vdc in |
|---|---|---|
| 100000 | 99910 | 1000 |
| 999100 | 99910 | 1000 |
| 90000 | 9000 | 900 |
| 899100 | 9000 | 900 |
| 80000 | 8000 | 800 |
| 799100 | 8000 | 800 |
| 70000 | 7000 | 700 |
| 699100 | 7000 | 700 |
| 60000 | 6000 | 600 |
| 599100 | 6000 | 600 |
| 50000 | 5000 | 500 |
| 499100 | 5000 | 500 |
| 40000 | 4000 | 400 |
| 399100 | 4000 | 400 |
| 30000 | 3000 | 300 |
| 299100 | 3000 | 300 |
| 20000 | 2000 | 200 |
| 199100 | 2000 | 200 |
| 10000 | 1000 | 100 |
| 099100 | 1000 | 100 |
| 09000 | 0900 | 100 |
| 089100 | 0900 | 100 |
| 08000 | 0800 | 100 |
| 079100 | 0800 | 100 |
| 07000 | 0700 | 100 |
| 069100 | 0700 | 100 |
| 06000 | 0600 | 100 |
| 059100 | 0600 | 100 |
| 05000 | 0500 | 100 |
| 049100 | 0500 | 100 |
| 04000 | 0400 | 100 |
| 039100 | 0400 | 100 |
| 03000 | 0300 | 100 |
| 029100 | 0300 | 100 |
| 02000 | 0200 | 100 |
| 019100 | 0200 | 100 |
| 01000 | 0100 | 100 |
| 009100 | 0100 | 100 |
| 00900 | 0090 | 100 |
| 008100 | 0090 | 100 |
| 00800 | 0080 | 100 |
| 007100 | 0080 | 100 |
| 00700 | 0070 | 100 |
| 006100 | 0070 | 100 |
| 00600 | 0060 | 100 |
| 005100 | 0060 | 100 |
| 00500 | 0050 | 100 |
| 004100 | 0050 | 100 |
| 00400 | 0040 | 100 |
| 003100 | 0040 | 100 |
| 00300 | 0030 | 100 |
| 002100 | 0030 | 100 |
| 00200 | 0020 | 100 |
| 001100 | 0020 | 100 |
| 00100 | 0010 | 100 |
| 000100 | 0010 | 100 |

Figure 4-8. KELVIN-VARLEY DIVIDER ERROR LIMITS

c. Measure voltage across Q201 (test point 2 to test point 3) with a VTVM.
d. Adjust R209 so that VTVM indicates 6 volts.
e. Connect VTVM from drain of Q501 (see Figure 4-6) to COMMON post.
f. Set polarity switch to AC.
g. Adjust R507 so that VTVM indicates +11 (±0.5) volts.

4-56. NULL DETECTOR ZERO. If the meter deflects off-null, after being mechanically zeroed with the meter terminals shorted, the null detector is out of electrical zero, and needs adjustment. Proceed as follows:

a. Short INPUT post to COMMON post.
b. After 3 minutes, zero the meter mechanically.
c. Set switches on voltmeter as follows:

| | |
|---|---|
| RANGE | 1 |
| NULL | .001 |
| polarity | + (positive) |
| voltage readout dials | zero |

d. Meter offset should be less than 1/4 small scale division when the polarity switch is rotated; if not, adjust R227 as necessary to zero the meter.
e. Remove the short from the input: meter offset should remain within 1/3 small scale division in both dc polarities.

4-57. CONVERTER SUPPLY CHECK AND ADJUSTMENT. Resistor R539 may require adjustment if a part is replaced in the +18 volt supply. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A.
b. Connect a VTVM across C522. Also connect the 910A rms voltmeter across C522.
c. Adjust R539 so that the VTVM indicates +18 (±0.1) volts dc. Ripple indicated by the 910A should not exceed 200 microvolts rms.

4-58. ADJUSTMENT OF CONVERTER OUTPUT. The converter output level may require adjustment if Q506 or an associated part is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 873AB, or to ON with 873A.
b. Connect a VTVM from the collector of Q506 to the COMMON post.
c. Set the polarity switch to AC.
d. Adjust R521 so that VTVM indicates 9.5 (+0.5, -1.5) volts. Adjustment to 9.5 volts from the upper limit is usually easier.

4-59. MECHANICAL DRUM ADJUSTMENTS

4-60. Occasionally the need may arise to align the polarity switch drum or one of the voltage dial drums in the readout windows. Also, if the drive gear on a switch or dial shaft is no longer in line with the drum shaft, the gears may bind as the dials are rotated. Align as follows:

a. Remove both side front-covers and the bottom cover from 873A.

b. Stand instrument on rear.

c. Make sure that drive gear on polarity switch shaft and drive gear on shaft of voltage dial D are in line with drum shaft. If not, loosen set screw of drive gear with a 1/16" hex key and align drive gear with drum shaft.

d. Loosen adjusting bracket at left side of instrument and position drum shaft up or down until there is just discernible backlash. That is, until polarity drum just moves when rotated with a finger without moving drive gear on polarity switch shaft.

e. Loosen adjusting bracket at right side of instrument and position drum shaft until there is just discernible backlash for drum of voltage dial D.

f. Turn polarity switch and all voltage dials fully counterclockwise.

g. Loosen set screw of drive gear for drum being aligned and slide drive gear toward back of instrument.

*Note!*

See step l. for adjustment of voltage dial D.

h. Insert finger through window and hold drum being aligned in desired position.

i. Insert hex key into set screw of drive gear and lift drive gear into place allowing it to turn counterclockwise as the teeth mesh.

j. When drive gear is in line with drum shaft tighten set screw.

k. Check character alignment in window. If necessary, loosen set screw and rotate drive gear slightly for final adjustment.

l. To align drum for voltage dial D, loosen set screw of drive gear and slide toward rear of instrument.

m. Insert hex key into set screw of drive gear and lift drive gear into alignment with drive shaft while noting how much drum turns.

n. Slide drive gear toward rear of instrument.

o. Position drum so that oo position will line up with pointer when gear is raised into position.

p. Raise drive gear into alignment with drum shaft and position 00 in line with pointer by rotating drive gear slightly before tightening set screw.

# SECTION V

# LIST OF REPLACEABLE PARTS

## 5-1. INTRODUCTION

5-2. This section contains information necessary to describe all normally replaceable parts. Separate assembly lists are used to describe the parts on the final assembly and various assemblies and subassemblies. Each list has a corresponding illustration on which the parts for that list are identified. Parts are called out on both lists and illustrations by reference designations from the schematic diagram. Those parts (mechanical) which have no reference designation are shown on the illustrations by Fluke stock number.

5-3. Each list provides the following information on each part:

a. The REF DESIG. column indicates the reference designation used on the schematic diagram.

b. The DESCRIPTION column describes the part in words, along with any applicable values, tolerances, etc. Indentation is used to show assembly, subassembly, and parts relationship. See abbreviations and symbols on next page.

c. Entries in the FLUKE STOCK NO. column indicate the number by which Fluke stocks the part. This number should be used when ordering parts from the Fluke factory or your Fluke representative.

d. Entries in the MFR. column indicate a typical manufacture of the part by the manufacturer's code number. Appendix A lists the manufacturers and their code numbers.

e. Entries in the MFR. PART NO. column are part numbers assigned by the manufacturer indicated in the Mfg. column.

f. The number in the TOT. QTY. column indicates the total quantity of the part used in the instrument. "REF" indicates that the total quantity of the part has been previously given. The total quantity of each part is listed the first time the part appears. All other listings of the same part refer back to the reference designation of the first appearance of the part for the total quantity.

g. The number in the REC. QTY. column indicates the recommended spares quantity necessary to support approximately one to five instruments for a period of two years. The basis used to select the recommended spares quantity is that a small group of parts will be required to correct a majority of the problems that occur. Since there is a chance that any part may fail, a stock of at least one of every part used in addition to the recommended parts will be needed for complete maintenance during one year of isolated service.

h. The USE CODE column identifies certain parts which have been added, deleted, or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List at the end of this section. These changes are normally made when improved components become available or when the latest circuit improvements are developed by our engineering department. The serial number listed indicates the instruments in which that particular part was used. The symbol "~" is used to indicate an approximate use code. If a different part should be used for replacement, it is listed by Fluke stock number in the description column.

## 5-4. HOW TO OBTAIN PARTS

5-5. Standard components have been used whenever possible. Thus, most parts can be obtained locally. However, parts may be ordered directly from the manufacturer using the manufacturer's part number or from Fluke using the Fluke stock number. In addition, the most commonly replaced parts that can not be obtained locally may be obtained from your Fluke representative. If a part you have ordered has been replaced by a new or improved part, Fluke will normally send you this part along with an explanation.

5-6. When ordering parts from Fluke always include:

a. Reference designation, description, and Fluke stock number.

b. Instrument model and serial number.

c. Most structural parts are not listed. In this case, give complete description, function, and location of part.

## 5-7. ABBREVIATIONS AND SYMBOLS

### ABBREVIATIONS

| | | | |
|---|---|---|---|
| ac | alternating current | mw | milliwatt |
| Al | aluminum | na | nanoampere |
| assy | assembly | pf | picofarad |
| cap | capacitor | piv | peak inverse voltage |
| car flm | carbon film | plstc | plastic |
| cer | ceramic | pp | peak-to-peak |
| comp | composition | ppm | parts per million |
| conn | connector | rect | rectifier |
| cps | cycles per second | res | resistor |
| db | decibel | rms | root-mean-square |
| dc | direct current | sb | slow-blow |
| dpdt | double pole double throw | Si | silicon |
| dpst | double pole single throw | S/N | serial number |
| elect | electrolytic | sw | switch |
| fxd | fixed | spdt | single pole double throw |
| Ge | germanium | spst | single pole single throw |
| gmv | guaranteed minimum value | Ta | tantalum |
| Hz | hertz (cycles per second) | tc | temperature coefficient |
| K | kilohm | tstr | transistor |
| kc or Kc | kilocycle | ua | microampere |
| kHz or KHz | kilohertz (kilocycles per sec) | uf | microfarad |
| kv | kilovolt | uv | microvolt |
| kva | kilovolt-ampere | va | volt ampere |
| ma | milliampere | vac | alternating current volts |
| Mc or MC | megacycle | var | variable |
| MHz | megahertz (megacycles per sec) | vdc | direct current volts |
| meg or M | megohm | w | watt |
| met flm | metal film | wvdc | direct current working volts |
| mfg | manufacturer | ww | wirewound |
| mv | millivolt | | |

### PREFIX SYMBOLS

| | | |
|---|---|---|
| T | tera | $10^{12}$ |
| G | giga | $10^{9}$ |
| M | mega | $10^{6}$ |
| K or k | kilo | $10^{3}$ |
| h | hecto | $10^{2}$ |
| da | deka | 10 |
| d | deci | $10^{-1}$ |
| c | centi | $10^{-2}$ |
| m | milli | $10^{-3}$ |
| u | micro | $10^{-6}$ |
| n | nano | $10^{-9}$ |
| p | pico | $10^{-12}$ |
| f | femto | $10^{-15}$ |
| a | anto | $10^{-18}$ |

### QUANTITY SYMBOLS

| | |
|---|---|
| a or amp | ampere |
| f | farad |
| h | henry |
| hr | hour |
| Ω | ohm |
| sec | second |
| v or V | volt |
| w or W | watt |

### SPECIAL NOTES AND SYMBOLS

~ Approximate use code, or serial number.

Use 0000-000000

Part number indicated should be used if replacement is required.

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Final Assembly (see Figure 5-1) | | | | | | |
| | (Line-powered model) | 873A | 89536 | | | | |
| | (Battery/line-powered model) | 873AB | 89536 | | | | |
| | Front Panel Assembly (see Figure 5-2) | | | | 1 | | |
| | (873A) | 3158-169029 | 89536 | 3158-169029 | | | |
| | (873AB) | 3158-169169 | 89536 | 3158-169169 | | | |
| | Wiring Assembly (see Figure 5-3) | | | | 1 | | |
| | (873A) | 3158-169037 | 89536 | 3158-169037 | | | |
| | (873AB) | 3158-169177 | 89536 | 3158-169177 | | | |
| | Reference Supply Assembly (see Figure 5-4) | 1702-167684 | 89536 | 1702-167684 | 1 | | |
| | Null Detector Assembly (see Figure 5-5) | 1702-167676 | 89536 | 1702-167676 | 1 | | |
| | Kelvin-Varley Resistor Assembly (see Figure 5-6) | 3158-167668 | 89536 | 3158-167668 | 1 | | |
| | Attenuator PCB Assembly (see Figure 5-7) | 1702-169011 | 89536 | 1702-169011 | 1 | | |
| | Converter Assembly (see Figure 5-8) | 1702-169003 | 89536 | 1702-169003 | 1 | | |
| C2 | Cap, plastic, 0.47 uf ±20%, 1000V | 1507-161612 | 14752 | 210B1G474 | 1 | | |
| C4 | Cap, plastic, 0.01 uf ±20%, 1000V (not illustrated) | 1509-159996 | 84411 | 663UW103010W | 2 | | D |
| F1 | Fuse, 1/16 amp, 125V, slow-blowing (115V operation of 873A) | 5101-163030 | 03614 | Type MDL | 1 | 3 | |
| | Fuse, 1/32 amp, 250V, slow-blowing (230V operation of 873A) | 5101-163022 | 03614 | Type MDL | 1 | 3 | |
| | Fuse, 1/8 amp, 250V, slow-blowing (115V or 230V operation of 873AB) | 5101-166488 | 03614 | Type MDL | 1 | 3 | |
| J4, J5 | Binding post, red | 2811-142976 | 58474 | DF31RC | 4 | | |
| J6 | Jack, line cord, 3 pin | 2109-160275 | 73586 | M-1550-Gs | 1 | | |
| R7 | Res, var, comp, 10K ±10%, 1/2W | 4701-162800 | 12697 | Series 37 | 1 | | |
| R10 | Res, comp, 10M ±10%, 1/2W (not illustrated) | 4704-108142 | 01121 | EB1061 | 1 | | |
| T1 | Transformer, power | 5602-169342 | 89536 | 5602-169342 | 1 | | |
| | Drum Assembly, polarity | 2403-162883 | 89536 | 2403-162883 | 1 | | |
| | Drum Assembly, 0-10 | 2403-162891 | 89536 | 2403-162891 | 3 | | |
| | Drum Assembly, 0-100 | 2403-162909 | 89536 | 2403-162909 | 1 | | |
| | Gear, nylon | 3155-154682 | 08863 | 3155-154682 | 5 | | |

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Fuseholder | 2102-160846 | 75915 | 34-2004 | 1 | | |
| | Knob, 5/8" dia. | 2405-158949 | 89536 | 2405-158949 | 5 | | |
| | Knob, 1" dia, w/bar | 2405-158956 | 89536 | 2405-158956 | 3 | | |
| | Bail, wire | 3153-163386 | 89536 | 3153-163386 | 1 | | |
| | Rubber feet | 2819-103309 | 83478 | 9102-W | 4 | | |
| | Line cord (not illustrated) | 6005-161638 | 91934 | 019-1, SVT, 107-1 | 1 | | |
| | Top cover | 3156-167619 | 89536 | 3156-167619 | 1 | | |
| | Side cover | 3156-167635 | 89536 | 31536-167635 | 2 | | |
| | Handle | 2404-101857 | 12136 | 919-415-173 | 1 | | |
| | Bottom cover | 3156-167627 | 89536 | 3156-167627 | 1 | | |
| | Side cover, front | 3156-162164 | 89536 | 3156-162164 | 2 | | |
| | Battery cover (873AB only) | 3155-162305 | 89536 | 3155-162305 | 2 | | |

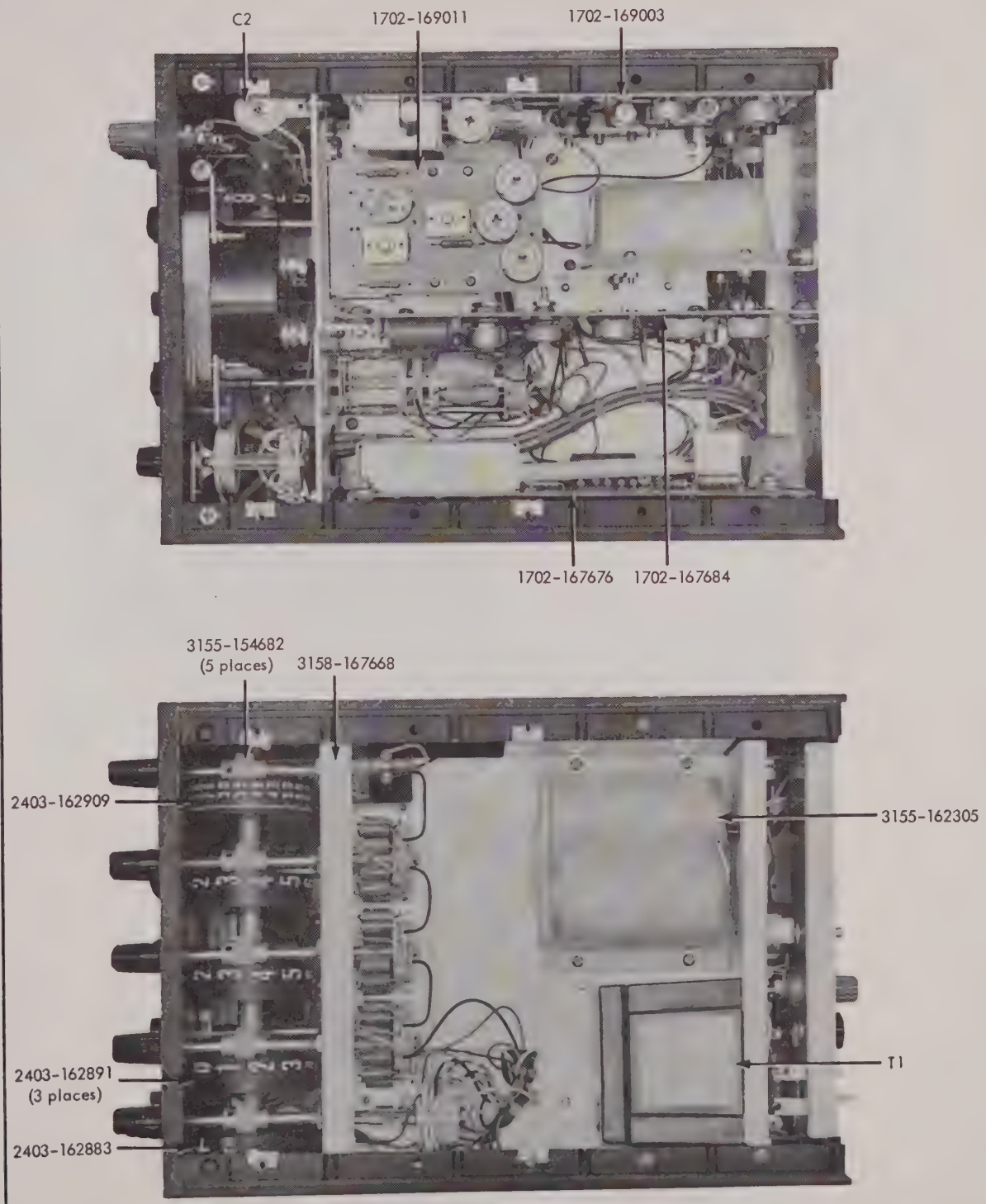



Figure 5-1. FINAL ASSEMBLY (Sheet 1 of 2)

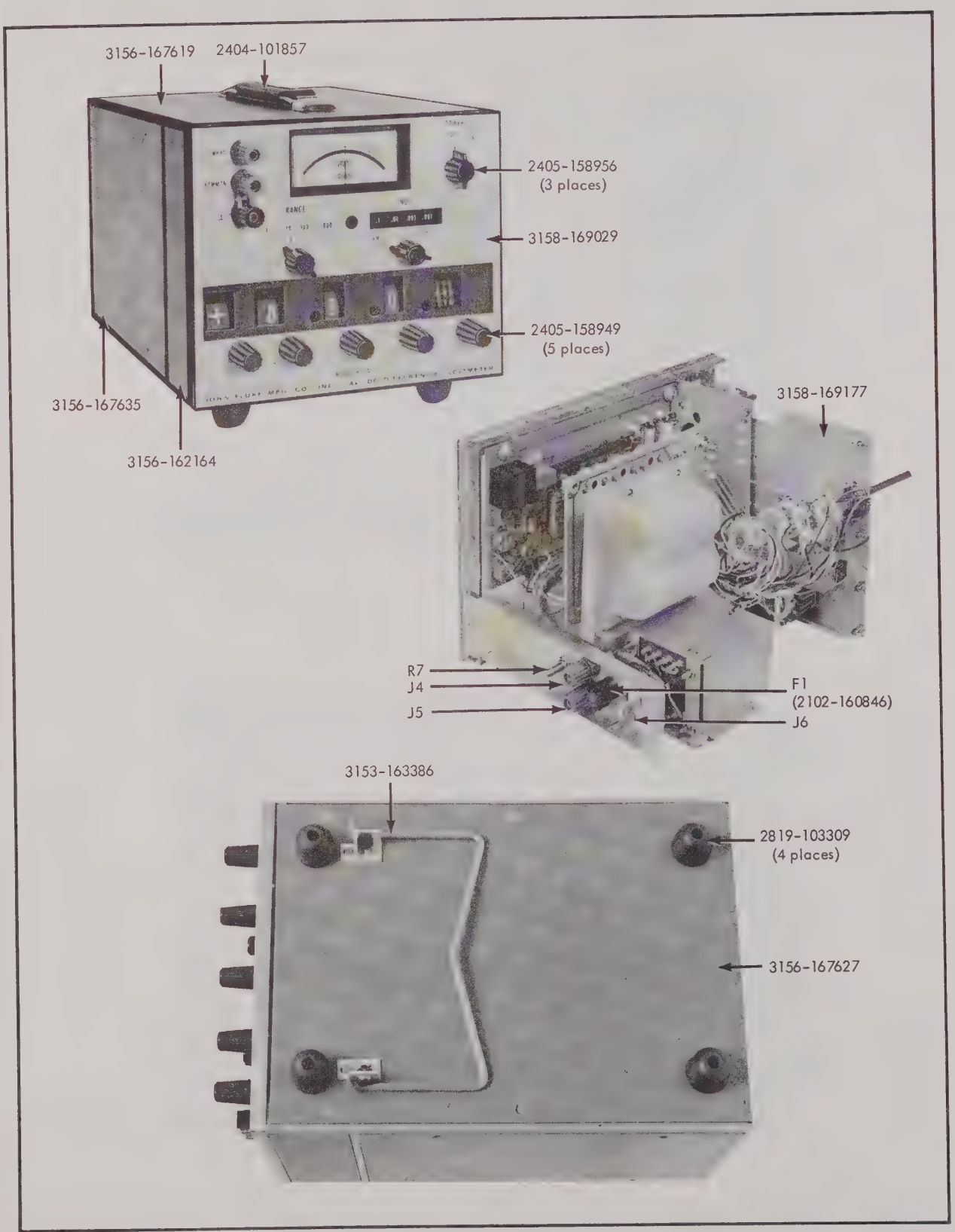



Figure 5-1. FINAL ASSEMBLY (Sheet 2 of 2)

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Front Panel Assembly (873A)<br>(873AB) | 3158-169029<br>3158-169169 | 89536<br>89536 | | 1 | | |
| C1 | Cap, plastic, 0.01 uf ±20%, 1000V | 1509-159996 | 84411 | 663UW103010W | REF | | |
| C5 | Cap, elect, 640 uf -10/+50%, 6.4V (not illustrated) | 1502-178608 | 73445 | ARC640 | 1 | | |
| J1, J2 | Binding post, red | 2811-142976 | 58474 | DF31RC | REF | | |
| J3 | Binding post, black | 2811-142984 | 58474 | DF31BC | 1 | | |
| M1 | Voltmeter, 100-0-100 ua, 900 ohms (873A only) | 2901-159202<br>2901-201236 | 89536<br>38315 | 2901-159202<br>Type MS24T | 1 | | |
| | Voltmeter, 100-0-100 ua, 900 ohms (873AB only) | 2901-160382<br>2901-201244 | 89536<br>38315 | 2901-160382<br>Type MS24T | 1 | | |
| R10 | Resistor, 270Ω, 1/2W, 10% (not illus.) | 4704-108241 | 01121 | RC20 | 1 | | |

NOTE:
Delete R10 and C5 for voltmeters 2901-159202 and 2901-160382. R10 and C5 are added to provide external damping for voltmeter 2901-201236 and 2901-201244. External damped meters are preferred replacements.

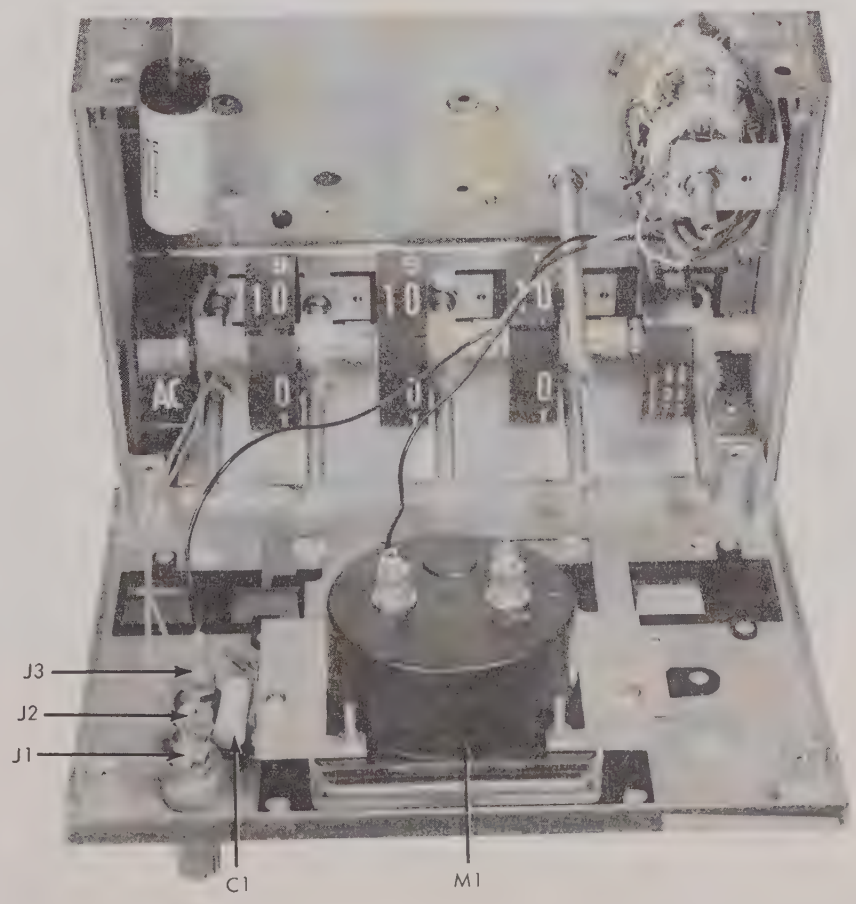



Figure 2. FRONT PANEL ASSEMBLY

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Wiring Assembly | | | | 1 | | |
| | (873A only) | 3158-169037 | 89536 | 3158-169037 | | | |
| | (873AB only) | 3158-169177 | 89536 | 3158-169177 | | | |
| C3 | Cap, plastic, 1 uf ±20%, 200V (not illustrated) | 1507-106450 | 84411 | X663UW10502 | 1 | | |
| R1, R2 | Res, met flm, 4.5M ±1%, 1W | 4705-159418 | 14298 | CM-1 | 2 | | |
| R3 | Res, met flm, 900K ±1%, 1W | 4705-159509 | 19701 | Type MF8C-TO | 1 | | |
| R4 | Res, met flm, 90K ±1%, 1/2W | 4705-159426 | 75042 | Type CEC-TO | 1 | | |
| R5 | Res, met flm, 9K ±1%, 1/2W | 4705-159434 | 75042 | Type CEC-TO | 1 | | |
| R6 | Res, met flm, 1K ±1%, 1/2W | 4705-151324 | 75042 | Type CEC-TO | 1 | | |
| R9 | Res, comp, 100K ±5%, 1/2W (873AB only) (not illustrated) | 4704-168054 | 01121 | EB1045 | 1 | | |
| S1 | Switch, 2 poles, 2 positions (873A only) | 5105-162693 | 89536 | 5105-162693 | 1 | | |
| | Switch, 8 poles, 5 positions (873AB only) | 5105-163360 | 89536 | 5105-163360 | 1 | | |
| S2 | Switch, 8 poles, 4 positions | 5105-162719 | 89536 | 5105-162719 | 1 | | |
| S3 | Switch, 7 poles, 5 positions | 5105-162669 | 89536 | 5105-162669 | 1 | | |
| S4 | Switch, 8 poles, 3 positions | 5105-162701 | 89536 | 5105-162701 | 1 | | R |
| | Switch, 8 poles, 3 positions | 5105-200782 | 89536 | 5105-200782 | 1 | | G |

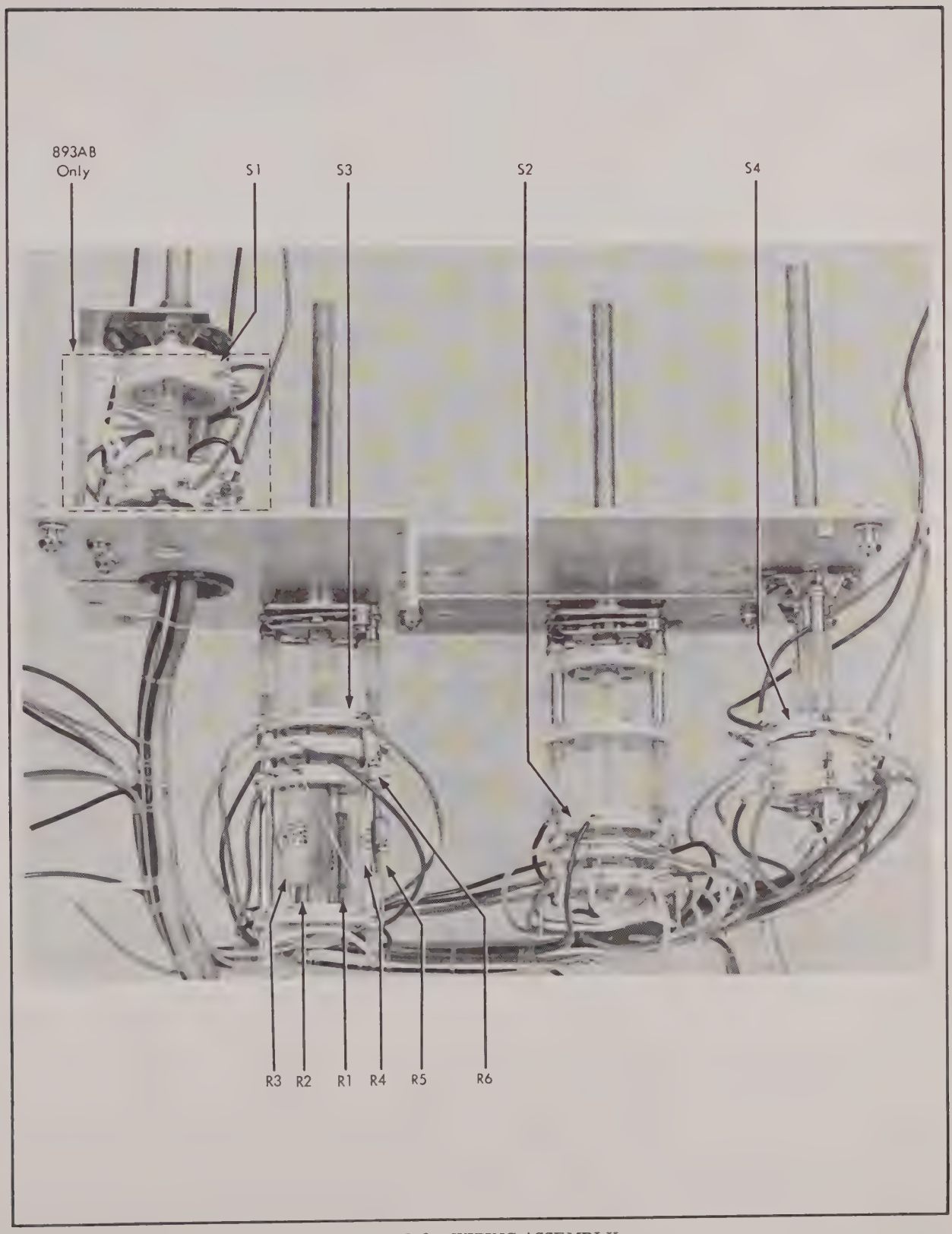



Figure 5-3. WIRING ASSEMBLY

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Reference Supply Assembly | 1702-167684 | 89536 | 1702-167684 | 1 | | |
| | Zener-Resistor Set | 3158-175091 | 89536 | 3158-175091 | 1 | | |
| CR103, CR104 | Diode, zener, aged, Type 1N3497 | 1 | 89536 | | 2 | | |
| R117 | Res, WW, 675Ω ±1%, 1/2W | 2 | 89536 | | 1 | | |
| R118 | Res, WW, 7.5K to 10K Factory Selected | 2 | 89536 | | 1 | | |
| C101 | Cap, Al, elect, 150 uf -10/+150%, 50V | 1502-160119 | 88419 | BR150-50 | 1 | 1 | A |
| | Cap, Al, elect, 160 uf -10/+50%, 64V | 1502-170274 | 73445 | C437ARH160 | 1 | 1 | B |
| C102 | Cap, Al, elect, 20 uf -10/+75%, 50V | 1502-106229 | 06001 | 76F02LK200 | 2 | 1 | A |
| | Cap, Al, elect, 50 uf -10/+50%, 25V | 1502-168823 | 73445 | C426ARF50 | 2 | 1 | AB |
| | Cap, Al, elect, 400 uf -10/+50%, 25V | 1502-168153 | 73445 | C437ARF400 | 1 | 1 | ~AD |
| CR101, CR102 | Diode, Si, 100 PIV, 1A (CR102 used on 873AB only) | 4802-116111 | 05277 | 1N4817 | 4 | 1 | |
| Q101 | Transistor, NPN, Si | 4805-153551 | 07910 | CD10449 | 4 | 1 | ~F |
| | Transistor, NPN, Si | 4805-150359 | 95303 | 2N3053 | 2 | 1 | ~F |
| | Transistor, NPN, Si | 4805-117135 | 95303 | 2N2270 | 1 | 1 | ~N |
| | Transistor, NPN, Si (If replacement of Q101 is required use 4805-203489, CDQ10656) | 4805-203489 | 07910 | CDQ10656 | 3 | 1 | ~E |
| Q102, Q103 | Transistor, NPN, Si | 4805-153551 | 07910 | CD10449 | REF | | A |
| | Transistor, NPN, Si | 4805-168708 | 33173 | 2N3391 | 2 | 1 | B |
| | Transistor, NPN, Si (If replacement of Q102, Q103 is required, use 4805-203489, CDQ10656) | 4805-203489 | 07910 | CDQ10656 | REF | | ~A |
| Q104 | Transistor, PNP, Si | 4805-190389 | 04713 | SM4144 | 3 | 1 | |
| R101, R102, R103 | Res, WW, 3M ±.03%, 1W | 4707-165670 | 89536 | 4707-165670 | 3 | 1 | |
| R104 | Res, var, WW, 2K ±20%, 3W | 4702-167247 | 71450 | BJ49715 | 1 | | |
| R105 | Res, WW, 898.84K ±.03%, 1W | 4707-165654 | 89536 | 4707-165654 | 1 | 1 | |
| R106 | Res, var, comp, 250Ω ±30%, 0.3W | 4701-166983 | 71450 | Type 70 (without switch) | 1 | | |
| R107 | Res, WW, 99.91K ±.05%, 1/4W | 4707-165662 | 89536 | 4707-165662 | 1 | 1 | |
| R108 | Res, comp, 270Ω ±10%, 1/2W | 4704-108241 | 01121 | EB2711 | 1 | | |
| R109 | Res, met flm, 4.99K ±1%, 1/2W | 4705-148890 | 75042 | Type CEC-TO | 1 | | |
| R110 | Res, met flm, 16.2K ±1%, 1/2W | 4705-170928 | 75042 | Type CEC-TO | 1 | | |
| R111 | Res, var, WW, 1K ±20%, 1-1/4W | 4702-111575 | 71450 | Type 110 | 1 | | |
| R112 | Res, comp, 10K ±10%, 1/2W | 4704-108118 | 01121 | EB1031 | 4 | | |

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| R113 | Res, comp, 47K ±10%, 1/2W | 4704-108480 | 01121 | EB4731 | 3 | | |
| R114 | Res, comp, 10K ±10%, 1/2W | 4704-108118 | 01121 | EB1031 | REF | | |
| R115 | Res, comp, 5.6K ±10%, 1/2W | 4704-108324 | 01121 | EB5621 | 4 | | |
| R116 | Res, comp, 1M ±10%, 1/2W | 4704-108134 | 01121 | EB1051 | 2 | | F |
| | Res, comp, 680K ±10%, 1/2W | 4704-108340 | 01121 | EB6841 | 1 | | O |
| R119 | Res, var, WW, 25Ω ±10%, 1-1/4W | 4702-161703 | 71450 | Type 110 | 1 | | |
| R120 | Res, WW, 49.45K ±.03%, 1W | 4707-167353 | 89536 | 4707-167353 | 1 | 1 | |
| R121 | Res, var, WW, 100Ω ±20%, 1-1/4W | 4702-112797 | 71450 | Type 110 | 2 | | |
| R122 | Res, WW, 6.111K ±.03%, 1W | 4707-163436 | 89536 | 4707-163436 | 1 | 1 | |
| R123 | Res, comp, 120Ω ±10%, 1W | 4704-109827 | 01121 | GB1211 | 1 | | |
| R124 | Res, comp, 3.9K ±10%, 1/4W (not illustrated) | 4704-148064 | 01121 | CB3921 | 1 | | P |
| | Polyethelene grommet | 2807-171876 | 89536 | 2807-171876 | 9 | 2 | |
| | Polyethelene grommet (not illustrated) | 2807-171884 | 89536 | 2807-171884 | 1 | 1 | |

1 If replacement is required, replace with a new Zener-Resistor Set.

2 This resistor is factory selected for each instrument. When ordering, include all information on old resistor and/or information on Reference Supply Board decal.

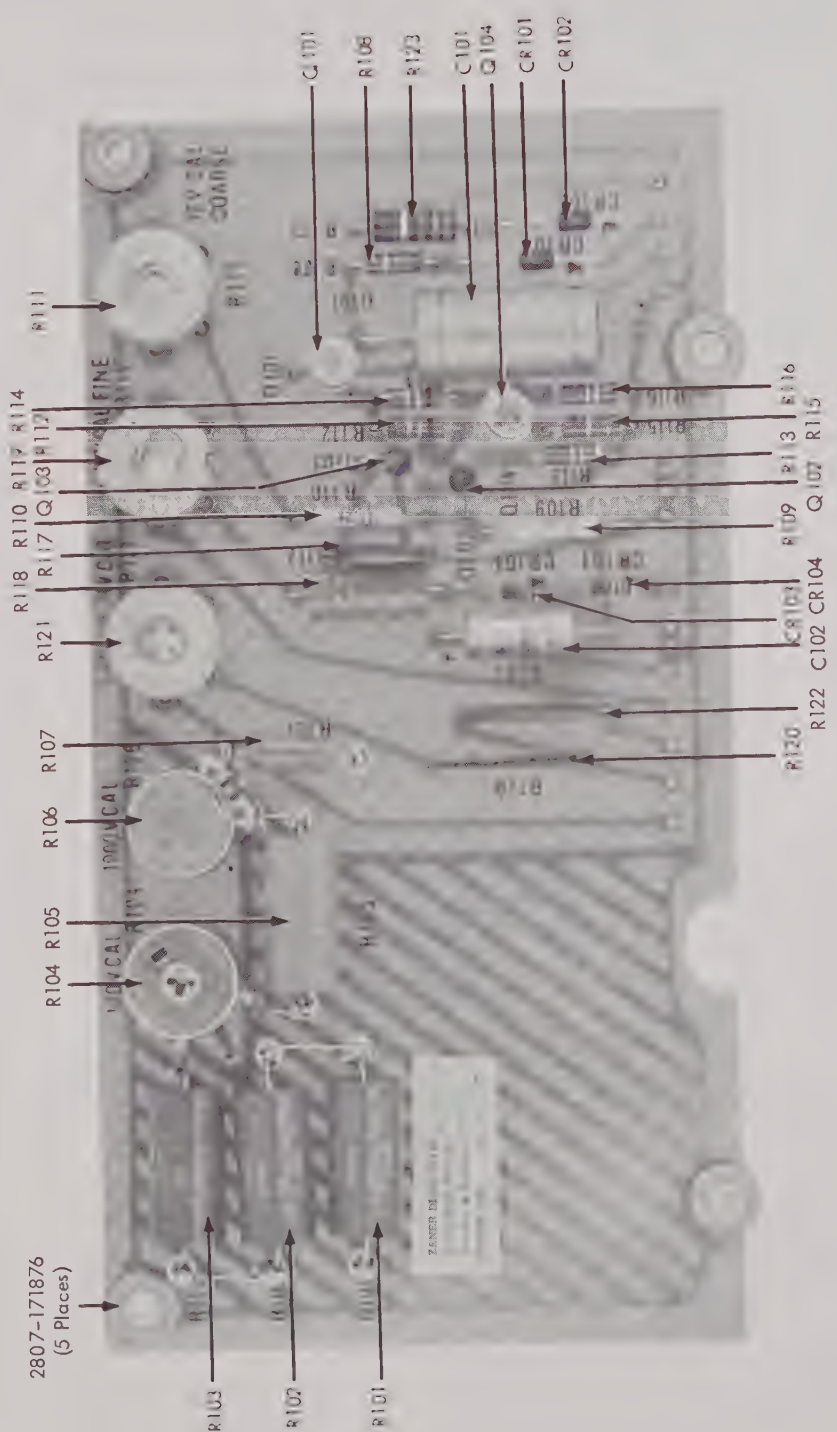



Figure 5-4. REFERENCE SUPPLY ASSEMBLY

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Null Detector Assembly | 1702-167676 | 89536 | 1702-167676 | 1 | | |
| C201 | Cap, plstc, .1 uf ±20%, 120V | 1507-167460 | 99217 | Type SEC | 1 | | |
| C202 | Cap, plstc, .22 uf ±20%, 120V | 1507-167452 | 99217 | Type SEC | 1 | | |
| C203 | Cap, plstc, .047 uf ±20%, 100V | 1507-106096 | 84411 | 663UW47301 | 2 | | |
| C204 | Cap, Al, elect, 100 uf -10/+75%, 25V | 1502-106518 | 56289 | 30D107G025DH4 | 1 | 1 | |
| C205 | Cap, Al, elect, 40 uf -10/+75%, 6V | 1502-105205 | 56289 | 30D406G006BB4 | 1 | 1 | H |
| | Cap, Al, elect, 50 uf -10/+50%, 25V | 1502-168823 | 73445 | C426ARF50 | 1 | | J |
| C206 | Cap, Al, elect, 5 uf -10/+75%, 25V | 1502-152009 | 56289 | 30D505G025BA4 | 3 | 1 | H |
| | Cap, Al, elect, 10 uf -10/+50%, 25V | 1502-170266 | 73445 | C426ARF10 | 3 | 1 | J |
| C207 | Cap, Al, elect, 1250 uf -10/+50%, 4V | 1502-166330 | 73445 | C437ARB1250 | 2 | 1 | |
| C208 | Cap, Al, elect, 5 uf -10/+75%, 25V | 1502-152009 | 56289 | 30D505G025BA4 | REF | | H |
| | Cap, Al, elect, 10 uf -10/+50%, 25V | 1502-170266 | 73445 | C426ARF10 | REF | | J |
| C209 | Cap, plstc, .0047 uf ±20%, 200V | 1507-106054 | 56289 | 192P47202 | 1 | | |
| C210 | Cap, cer, 500 pf ±10%, 500V | 1501-105692 | 56289 | 40C210 | 2 | | |
| C211 | Cap, plstc, .022 uf ±20%, 100V | 1507-106039 | 84411 | 663UW22301 | 1 | | |
| C212 | Cap, plstc, .047 uf ±20%, 100V | 1507-106096 | 84411 | 663UW47301 | REF | | |
| C213 | Cap, Al, elect, 5 uf -10/+75%, 25V | 1502-152009 | 56289 | 30D505G025BA4 | REF | | H |
| | Cap, Al, elect, 10 uf -10/+50%, 25V | 1502-170266 | 73445 | C426ARF10 | REF | | J |
| C214 | Cap, Al, elect, 1250 uf -10/+50%, 4V | 1502-166330 | 73445 | C437ARB1250 | REF | | |
| C215 | Cap, cer, 500 pf ±10%, 500V | 1501-105692 | 56289 | 40C210 | REF | | |
| C216 | Cap, cer, .01 uf ±20%, 50V | 1501-149153 | 13606 | C023B101F103 | 1 | | AG |
| CR201 | Diode, Si, Stabistor, 6 PIV, .15A (not illustrated) | 4802-113308 | 07910 | CD13161 | 1 | | H |
| DS201 | Lamp, neon (coated with epoxy resin) | 3902-162776 | 89536 | 3902-162776 | 1 | 1 | |
| DS202 | Lamp, neon (not illustrated) | 3902-162602 | 89730 | NE2U | 1 | 1 | |
| Q201 | Transistor, field effect, P-channel, Si | 4805-159210 | 17856 | SU443 | 1 | 1 | |
| Q202 | Transistor, PNP, Si | 4805-159491 | 04713 | SM4144 | 2 | 1 | K |
| | Transistor, PNP, Si | 4805-169375 | 65092 | 2N3638 | 4 | 1 | S |
| | Transistor, PNP, Si | 4805-195974 | 04713 | 2N3906 | 1 | | T |
| Q203 thru Q205 | Transistor, PNP, Ge | 4805-148643 | 01295 | 2N1307 | 3 | 1 | H |
| | Transistor, PNP, Si | 4805-169375 | 65092 | 2N3638 | 3 | | J |
| Q206, Q207 | Transistor, NPN, Ge | 4805-117127 | 01295 | 2N1304 | 2 | 1 | |
| Q208 | Transistor, NPN, Si | 4805-150359 | 95303 | 2N3053 | REF | | ~N |
| | Transistor, NPN, Si (If replacement of Q208 is required use 4805-203489, CDQ10656) | 4805-203489 | 07910 | CDQ10656 | REF | | ~E |

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| Q209 | Transistor, PNP, Si | 4805-159491 | 04713 | Same as Q202 | REF | 1 | H U T |
| | Transistor, PNP, Ge | 4805-148619 | 01295 | 2N1303 | 1 | | |
| | Transistor, PNP, Ge | 4805-182709 | 01295 | GA2877 | 1 | | |
| R201 | Res, comp, 270K ±10%, 2W | 4704-110023 | 01121 | HB2741 | 1 | | |
| R202 | Res, comp, 470K ±10%, 1/2W | 4704-108290 | 01121 | EB4741 | 3 | | |
| R203 | Res, met flm, 200Ω ±1%, 1/2W | 4705-151480 | 75042 | Type CEC-TO | 1 | | |
| R204 | Res, comp, 1.2M ±10%, 1/2W | 4704-108407 | 01121 | EB1251 | 1 | | |
| R205 | Res, comp, 2.2M ±10%, 1/2W | 4704-108225 | 01121 | EB2251 | 1 | | |
| R206 | Res, comp, 22K ±10%, 1/2W | 4704-108209 | 01121 | EB2231 | 2 | | |
| R207 | Res, comp, 1.8K ±10%, 1/2W (not illustrated) | 4704-108860 | 01121 | EB1821 | 3 | | |
| R208 | Res, met flm, 6.81K ±1%, 1/2W | 4705-162552 | 75042 | Type CEC-TO | 1 | | |
| R209 | Res, var, WW, 5K ±5%, 2W | 4702-111609 | 71450 | Type 115 | 1 | | |
| R210 | Res, comp, 120K ±10%, 1/2W | 4704-108779 | 01121 | EB1241 | 5 | | |
| R211 | Res, comp, 470K ±10%, 1/2W | 4704-108290 | 01121 | EB4741 | REF | | |
| R212 | Res, comp, 120K ±10%, 1/2W | 4704-108779 | 01121 | EB1241 | REF | | |
| R213 | Res, comp, 47K ±10%, 1/2W | 4704-108480 | 01121 | EB4731 | REF | | |
| R214 | Res, comp, 5.6K ±10%, 1/2W | 4704-108324 | 01121 | EB5621 | REF | | |
| R215 | Res, comp, 1.8K ±10%, 1/2W | 4704-108860 | 01121 | EB1821 | REF | | |
| R216 | Res, comp, 4.7Ω ±10%, 1/2W | 4704-165746 | 01121 | EB47G1 | 1 | | |
| R217 | Res, comp, 470K ±10%, 1/2W | 4704-108290 | 01121 | EB4741 | REF | | |
| R218, R219 | Res, var, comp, 100K ±20%, 1-1/4W | 4701-163873 | 71450 | Type UPE200 | 3 | | |
| R220, R221 | Res, comp, 120K ±10%, 1/2W | 4704-108779 | 01121 | EB1241 | REF | | |
| R222 | Res, comp, 1.8K ±10%, 1/2W | 4704-108860 | 01121 | EB1821 | REF | | |
| R223, R224 | Res, comp, 15K ±10%, 1/2W | 4704-108530 | 01121 | EB1531 | 4 | | |
| R225 | Res, comp, 47K ±10%, 1/2W | 4704-108480 | 01121 | EB4731 | REF | | |
| R226 | Res, comp, 120K ±10%, 1/2W | 4704-108779 | 01121 | EB1241 | REF | | |
| R227 | Res, var, comp, 100K ±20%, 1-1/4W | 4701-163873 | 71450 | Type UPE 200 | REF | | |
| R228 | Res, comp, 47M ±10%, 1/2W | 4704-146415 | 01121 | EB4761 | 1 | | |
| R229 | Res, comp, 15K ±10%, 1/2W | 4704-108530 | 01121 | EB1531 | REF | | |
| R230 | Res, comp, 3.3K ±10%, 1/2W | 4704-108373 | 01121 | EB3321 | 2 | | |

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| R231 | Res, var, WW, 100Ω ±20%, 1-1/4W | 4702-112797 | 71450 | Type 110 | REF | | |
| R232 | Res, met flm, 402Ω ±1%, 1/2W | 4705-150839 | 75042 | Type CEC-TO | 1 | | |
| R233 | Res, met flm, 17.8K ±1%, 1/2W | 4705-162545 | 75042 | Type CEC-TO | 1 | V | |
| | Res, met flm, 18.2K ±1%, 1/2W | 4705-217778 | 75042 | 4705-217778 | 1 | W | |
| R234 | Res, met flm, 14.7K ±1%, 1/2W | 4705-162537 | 75042 | Type CEC-TO | 1 | | |
| R235 | Res, met flm, 15.8K ±1%, 1/2W | 4705-171983 | 75042 | Type CEC-TO | 1 | V | |
| | Res, met flm, 15.0K ±1%, 1/2W | 4705-151498 | 75042 | Type CEC-TO | 1 | W | |
| R236, R237 | Res, comp, 10K ±10%, 1/2W | 4704-108118 | 01121 | EB1031 | REF | | |
| R238 | Res, comp, 5.6K ±10%, 1/2W | 4704-108324 | 01121 | EB5621 | REF | | L |
| R239 | Res, comp, 10K ±10%, 1/2W | 4704-108118 | 01121 | EB1031 | REF | | X |
| T201 | Transformer | 5602-167775 | 89536 | 5602-167775 | 1 | | |
| V201 | Photoelectric cell | 3700-200287 | 89536 | 3700-200287 | 1 | 1 | |
| | Rod, optical (not illustrated) | 3800-168047 | 89536 | 3800-168047 | 1 | | |
| | Polyethelene grommet, 3/8 x 1/4 | 2807-171876 | 89536 | 2807-171876 | REF | | |

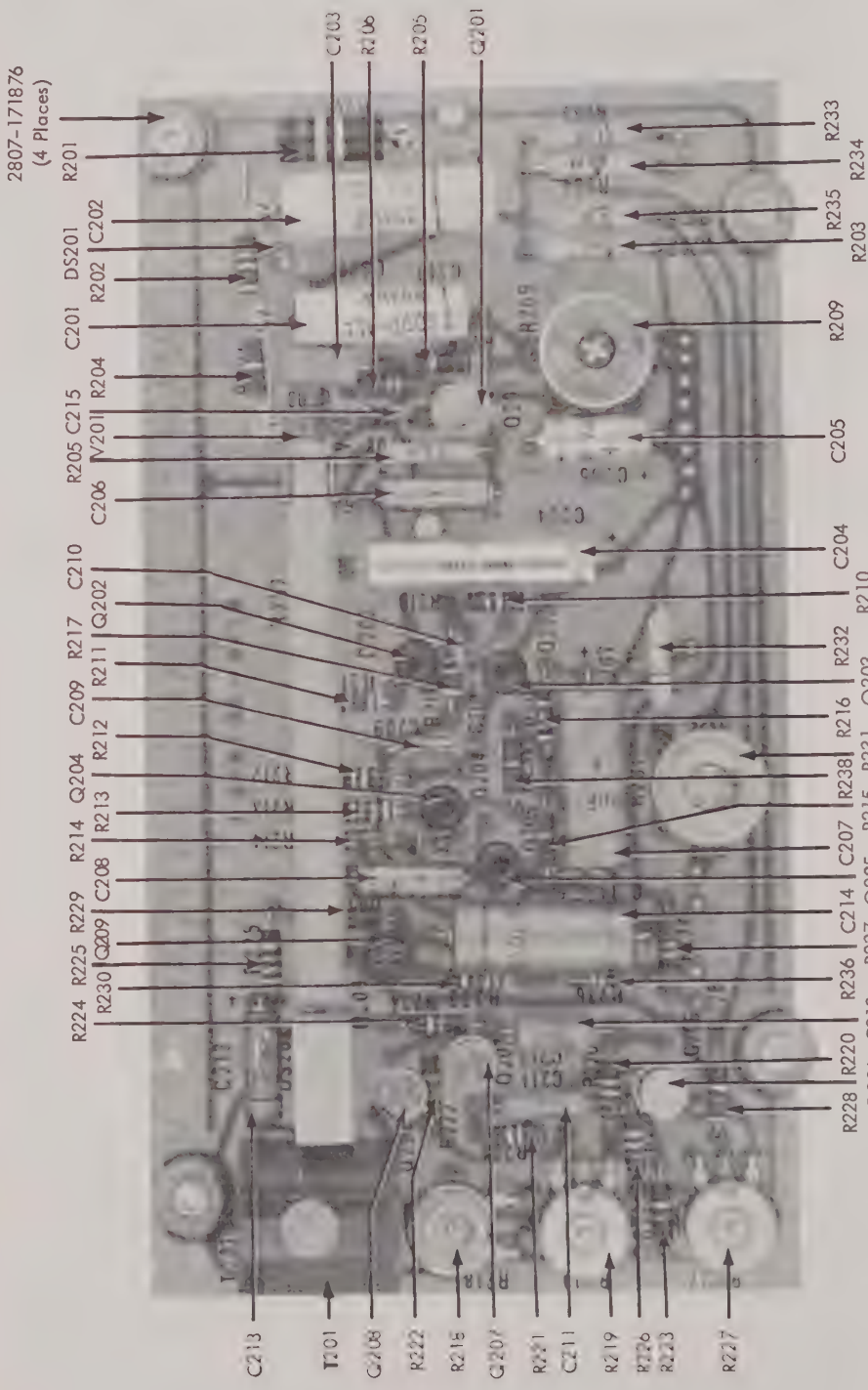



Figure 5-5. NULL DETECTOR ASSEMBLY

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Kelvin-Varley Resistor Assembly | 3158-167668 | 89536 | 3158-167668 | | | |
| R301 | Res, var, WW, 2.5K ±.5%, Dial "D" | 4711-163154 | 89536 | 4711-163154 | 1 | | |
| R302 | Res, WW, 476.2Ω ±.05%, 1/4W (not illustrated) | 4707-163956 | 89536 | 4707-163956 | 1 | | |
| R303 thru R313 | Res, WW, 200Ω ±.06%, 1/4W | 1 | 89536 | | 11 | | |
| R314 thru R324 | Res, WW, 1K ±.05%, 1/4W | 1 | 89536 | | 11 | | |
| R325 thru R336 | Res, WW, 5K ±.05%, 1/4W | 1 | 89536 | | 12 | | |
| S301 | Switch, rotary, Dial "A", 2 poles, 11 positions | 5105-162644 | 89536 | 5105-162644 | 1 | | |
| S302, S303 | Switch, rotary, Dials "B" & "C", 2 poles, 10 positions | 5105-162651 | 89536 | 5105-162651 | 2 | | |
| | 1 These resistors are factory matched for each instrument. When ordering, include all information stamped on old resistor and/or adjacent resistors. | | | | | | |

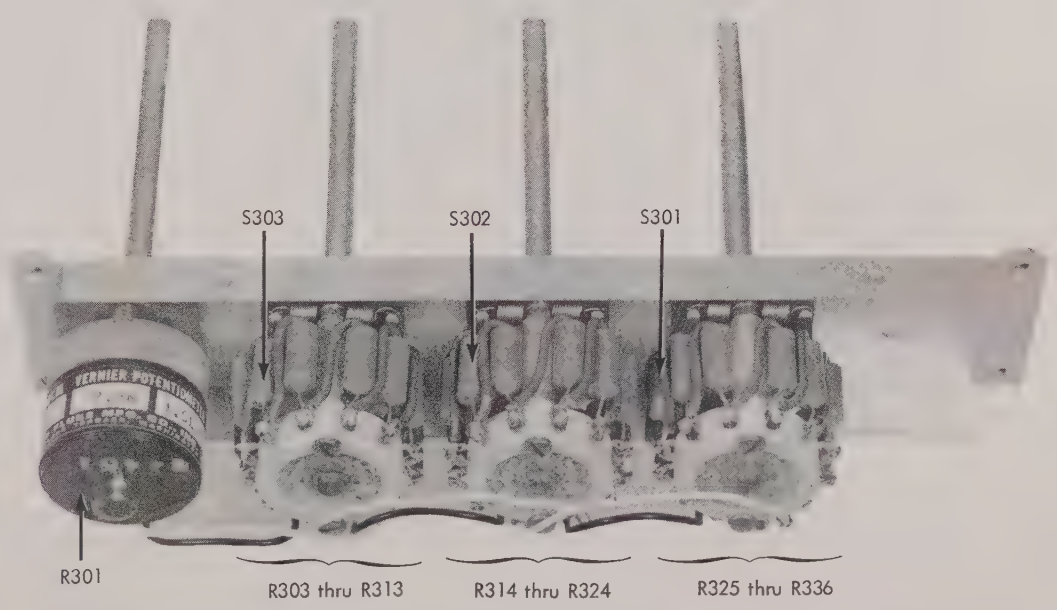



Figure 5-6. KELVIN-VARLEY RESISTOR ASSEMBLY

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Attenuator PCB Assembly | 1702-169011 | 89536 | 1702-169011 | 1 | | |
| C401 | Cap, treated, cer, 3.3 pf ±0.25 pf, 500V (Replace with 1501-178681) | 1501-169102 | 89536 | 1501-169102 | 1 | | ~A |
| | Cap, cer, 3 pf ±0.25 pf, 1100V | 1501-178681 | 00656 | Type C1-2 | 1 | | ~B |
| C402 | Cap, var, cer, 4.5 to 25 pf, 500V | 1509-167007 | 72982 | 503-001 | 1 | | |
| C403 | Cap, cer. treated, 1.8 f ±0.25 pf, 600 VDC (Replace with 1501-178673) | 1501-169094 | 89536 | 1501-169094 | 1 | | ~A |
| | Cap, cer, 1 pf ±0.1 pf, 1100V | 1501-178673 | 00656 | Type C1-2 | 2 | | ~B |
| C404 | Cap, var, trimmer, 9-180 pf, 175V | 1509-143347 | 02799 | 46-W-463 | 1 | | |
| C405 | Cap, var, trimmer, 80 to 480 pf, 175V | 1509-168112 | 02799 | 46-W-466 | 1 | | ~H |
| | Cap, var, trimmer, 170 to 780 pf | 1509-106245 | 02799 | 46-W-469 | 1 | | ~J |
| | Cap. assy, treated | 1501-170027 | 89536 | 1501-170027 | 1 | | ~A |
| C406, C407 | Cap, cer, 2.2 pf ±0.25 pf, 500V (C407 not illustrated) | | | | 2 | | |
| C406 | Cap, cer, 1 pf ±.1 pf, 1100V | 1501-178673 | 00656 | Type C1-2 | REF | | ~B |
| C408 | Cap, mica, 390 pf ±5 pf, 500V | 1504-148437 | 88419 | CD15F391J | 1 | | AE |
| | Matched Resistor Set | 4705-168021 | 89536 | 4705-168021 | 1 | | |
| R401 | Res, met flm, 900K ±0.25%, 1W | 1 | | | | | |
| R402 | Res, met flm, 110.5K ±0.25%, 1/2W | 1 | | | | | |
| R403 | Res, var, WW, 1.5K ±10%, 1-1/4W | 4702-156398 | 71450 | Type 110 | 1 | | |
| | Matched Resistor Set | 4705-168005 | 89536 | 4705-168005 | 1 | | |
| R404 | Res, met flm, 990K ±0.25%, 1W | 1 | | | | | |
| R405 | Res, met flm, 10.04K ±0.25%, 1/2W | 1 | | | | | |
| R406 | Res, var, WW, 150Ω ±20%, 1-1/4W | 4702-163642 | 71450 | Type 110 | 1 | | |
| | Matched Resistor Set | 4705-168039 | 89536 | 4705-168039 | 1 | | |
| R407 | Res, met flm, 1M ±0.25%, 2W | 1 | | | | | |
| R408 | Res, met flm, 995Ω ±0.25%, 1/2W | 1 | | | | | |
| R409 | Res, var, WW, 15Ω ±20%, 1-1/4W | 4702-163634 | 71450 | Type 110 | 1 | | |
| R410 | Res, comp, 180K ±10%, 1/2W | 4704-108431 | 01121 | EB1841 | 1 | | C |

1 If replacement is necessary, replace the matched set, and recalibrate the ac-to-dc converter.

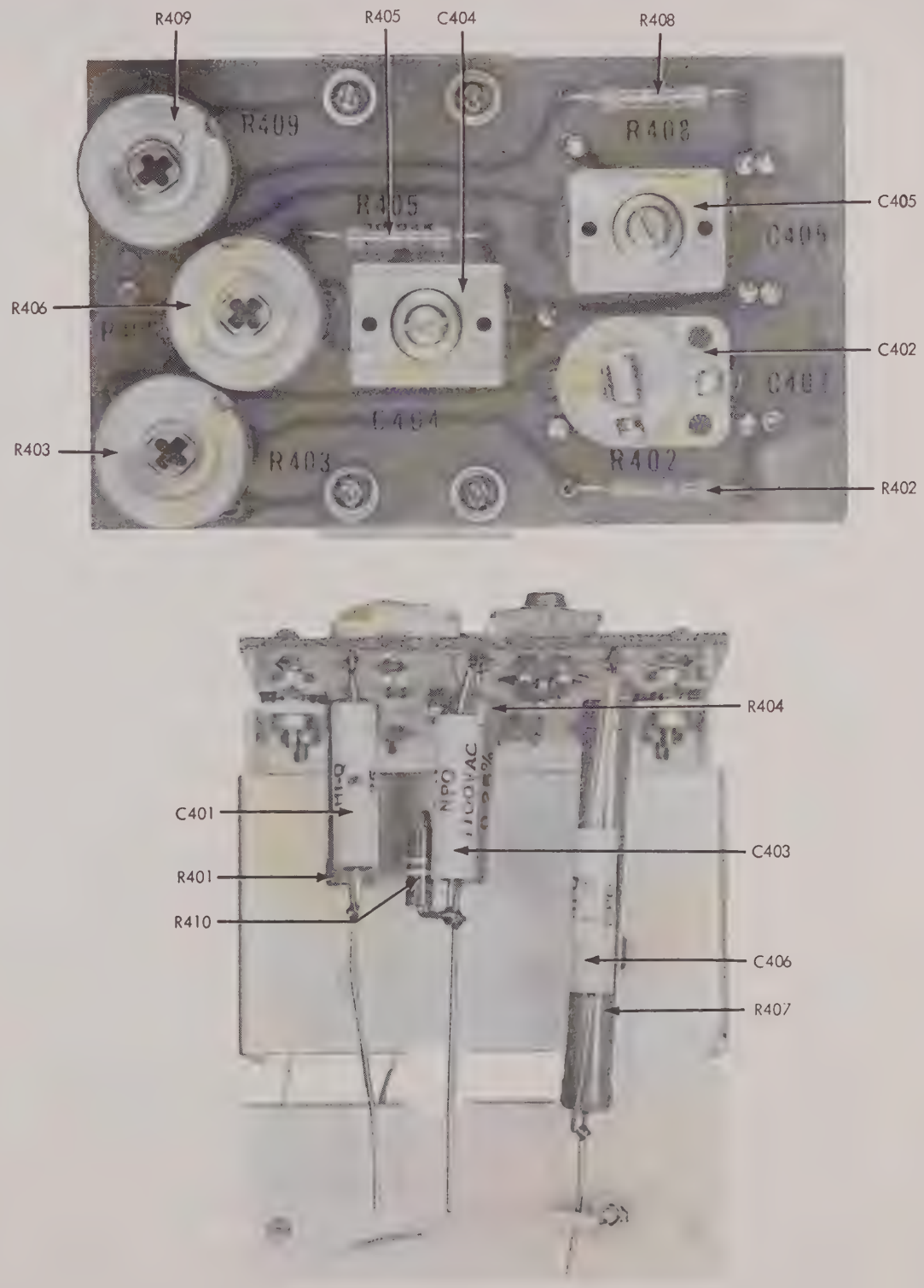



Figure 5-7. ATTENUATOR PCB ASSEMBLY

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| | Converter Assembly | 1702-169003 | 89536 | 1702-169003 | 1 | | |
| C501 | Capacitor treated, cer, 5.0 pf ±10%, 500V (Replace with 1501-187682) | 1501-166843 | 89536 | 1501-166843 | 1 | | ∼A |
| | Capacitor, cer, 5 pf ±.25 pf, 1100 V | 1501-187682 | 00656 | Type C1-2 | 1 | | ∼B |
| C502 | Cap, var, cer, treated 0.8 to 8.5 pf, 1250 VDC (Replace with 1509-188698) | 1509-106872 | 89536 | 1509-106872 | 1 | | ∼A |
| | Cap, var, cer, 1.0 to 10 pf, 400V | 1509-188698 | 91293 | JMC 2903 | 1 | | ∼B |
| C503 | Cap, cer, 15 pf ±10%, 500V | 1502-159947 | 00656 | C1-1 | 1 | | |
| C504 | Cap, plstc, 5 uf ±20%, 20V | 1507-160952 | 00656 | V-146-ZR | 1 | | |
| C505 | Cap, Al, elect, 30 uf -10/+75%, 15V | 1502-106492 | 06001 | 76F02FE300 | 2 | 1 | |
| C506 | Cap, Al, elect, 250 uf -10/+75%, 12V | 1502-160002 | 06001 | 76F02EN251 | 2 | 1 | |
| C507 | Cap, mica, 33 pf ±5%, 500V | 1504-160317 | 88419 | CD15E330J | 1 | | |
| C508 | Cap, Ta, elect, 68 uf ±20%, 6V | 1508-160242 | 05397 | K68P6 | 1 | 1 | |
| C509 | Cap, mica, 22 pf ±5%, 500V | 1504-148551 | 88419 | CD15E220J | 1 | | |
| C510 | Cap, Al, elect, 250 uf -10/+75%, 12V | 1502-160002 | 06001 | 76F02EN251 | REF | | |
| C511 | Cap, Ta, elect, 10 uf ±10%, 20V | 1508-160259 | 05397 | K10C20K | 1 | 1 | |
| C512 | Cap, plstc, 1000 pf ±10%, 200V | 1507-159582 | 56289 | 192P10292 | 1 | | |
| C513 | Cap, Ta, elect, 2.2 uf ±10%, 20V | 1508-160226 | 05397 | K2R2C20K | 2 | 1 | |
| C514 | Cap, Ta, elect, 150 uf ±10%, 6V | 1508-160234 | 05397 | K150C6K | 1 | 1 | |
| C515 | Cap, plstc, 470 pf ±10%, 200V | 1507-159574 | 56289 | 192P47192 | 1 | | |
| C516 | Cap, Ta, elect, 150 uf -15/+20%, 15V | 1508-160945 | 56289 | 109D157C2015 TO | 1 | 1 | |
| C517, C518 | Cap, plstc, 2 uf ±20%, 10V | 1507-160960 | 00656 | V-146-ZR | 2 | | |
| C519 | Cap, Al, elect, 50 uf -10/+75%, 50V | 1502-105122 | 06001 | 76F02LM500 | 1 | 1 | |
| C520 | Cap, Ta, elect, 2.2 uf ±10%, 20V | 1508-160226 | 05397 | K2R2C20K | REF | | |
| C521 | Cap, Al, elect, 30 uf -10/+75%, 15V | 1502-106492 | 06001 | 76F02FE300 | REF | | |
| C522 | Cap, Al, elect, 20 uf -10/+75%, 50V | 1502-106229 | 06001 | 76F02LK200 | 1 | | |
| CR501 | Diode, Si, 20 PIV, 0.010A | 4802-161810 | 03877 | SG5337 | 3 | 1 | |
| CR502 | Diode, Si, zener, 6.8V, 0.400W | 4803-166199 | 07910 | 1N754 | 2 | 1 | M |
| | Diode, Si, zener, 6.8V, 0.001A | 4803-187195 | 07910 | CD36554 | 2 | 1 | E |
| CR503 CR504 | Diode, Si, 20 PIV, 0.010A | 4802-161810 | 03877 | SG5337 | REF | | |
| CR505 | Diode, Si, 100 PIV, 1A | 4802-116111 | 05277 | 1N4817 | REF | | |

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| CR506 | Diode, Si, zener, 6.8V, 0.400W | 4803-166199 | 07910 | IN754 | REF | | M |
| | Diode, Si, zener, 6.8V, 0.001A | 4803-187195 | 07910 | CD36554 | REF | | E |
| CR507 | Diode, Si, 100 PIV, 1A | 4802-116111 | 05277 | IN4817 | REF | | |
| Q501 | Transistor, field-effect, N-channel | 4805-166223 | 15818 | U-1249 | 1 | 1 | |
| Q502 | Transistor, NPN, Si | 4805-159855 | 07910 | CS23030 | 5 | 1 | AF |
| | Transistor, NPN, Si | 4805-218081 | 04731 | MPS6520 | 1 | 1 | AB |
| Q503 thru Q506 | Transistor, NPN, Si | 4805-159855 | 07910 | CS23030 | 4 | 2 | |
| Q507 | Transistor, PNP, Si | 4805-190389 | 04713 | SM4144 | REF | | |
| Q508 | Transistor, NPN, Si | 4805-153551 | 07910 | CD10449 | REF | | N |
| | Transistor, NPN, Si (Use 4805-203489 for replacement) | 4805-203489 | 07910 | CDQ10656 | REF | | E |
| Q509 | Transistor, PNP, Si | 4805-190389 | 04713 | SM4144 | REF | | |
| | Matched Resistor Set | 4705-168013 | 89536 | 4705-168013 | 1 | | |
| R501 | Res, met flm, 1M ±0.25%, 1W (not illustrated) | | | | 1 | | |
| R502 | Res, met flm, 247.6K ±0.25%, 1/2W | | | | 1 | | |
| R503 | Res, var, WW, 5K ±5%, 1-1/4W | 4702-163709 | 71450 | Type 110 | 1 | | |
| R504 | Res, WW, 125Ω ±0.1%, 1/4W | 4707-159764 | 15909 | Type R1136 | 1 | | |
| R505 | Res, comp, 1M ±10%, 1/2W | 4704-108134 | 01121 | EB1051 | REF | | |
| R506 | Res, comp, 22K ±10%, 1/2W | 4704-108209 | 01121 | EB2231 | REF | | |
| R507 | Res, var, WW, 10K ±20%, 1-1/4W | 4702-112862 | 71450 | Type 110 | 1 | | |
| R508 | Res, comp, 10K ±5%, 1/2W | 4704-109165 | 01121 | EB1035 | 5 | | |
| R509 | Res, comp, 56K ±10%, 1/2W | 4704-108472 | 01121 | EB5631 | 1 | | AF |
| | Res, comp, 33K ±10%, 1/2W | 4704-178541 | 01121 | EB3331 | 1 | | AB |
| R510 | Res, comp, 16K ±5%, 1/2W | 4704-159632 | 01121 | EB1635 | 1 | | |
| R511 | Res, comp, 10K ±5%, 1/2W | 4704-109165 | 01121 | EB1035 | REF | | |
| R512 | Res, comp, 270Ω ±5%, 1/2W | 4704-159616 | 01121 | EB2715 | 1 | | |
| R513 | Res, comp, 2.7K ±5%, 1/2W | 4704-109074 | 01121 | EB2725 | 1 | | |
| R514 | Res, comp, 8.2Ω ±5%, 1/2W | 4704-159590 | 01121 | EB82G5 | 1 | | |
| R515 | Res, comp, 68K ±5%, 1/2W | 4704-159624 | 01121 | EB6835 | 1 | | |
| R516 | Res, comp, 27K ±10%, 1/2W | 4704-108878 | 01121 | EB2731 | 1 | | |
| R517 | Res, comp, 3.3K ±10%, 1/2W | 4704-108373 | 01121 | EB3321 | REF | | |
| R518 | Res, comp, 15K ±10%, 1/2W | 4704-108530 | 01121 | EB1531 | REF | | |
| R519 | Res, comp, 470Ω ±5%, 1/2W | 4704-108787 | 01121 | EB4715 | 2 | | |

| REF DESIG. | DESCRIPTION | FLUKE STOCK NO. | MFR. | MFR. PART NO. | TOT. QTY. | REC. QTY. | USE CODE |
|---|---|---|---|---|---|---|---|
| R520 | Res, comp, 62K ±5%, 1/2W | 4704-108522 | 01121 | EB6235 | 1 | | |
| R521 | Res, var, comp, 100K ±30%, 1/2W | 4701-160010 | 71450 | Type UPE70 | 1 | | |
| R522 | Res, comp, 300Ω ±5%, 1/2W | 4704-108829 | 01121 | EB3015 | 1 | | |
| R523 | Res, comp, 47Ω ±5%, 1/2W | 4704-159608 | 01121 | EB4705 | 1 | | |
| R524 | Res, comp, 470Ω ±5%, 1/2W | 4704-108787 | 01121 | EB4715 | REF | | |
| R525 | Res, comp, 330Ω ±10%, 1/2W | 4704-108589 | 01121 | EB3311 | 2 | | Y |
| | Res, comp, 150Ω ±10%, 1/2W | 4704-186056 | 01121 | EB1511 | 1 | | Z |
| R526 | Res, comp, 10K ±5%, 1/2W | 4704-109165 | 01121 | EB1035 | REF | | |
| R527 | Res, comp, 100K ±10%, 1/2W | 4704-108126 | 01121 | EB1041 | 1 | | |
| R528 | Res, comp, 5.6K ±10%, 1/2W | 4704-108324 | 01121 | EB5621 | REF | | A |
| | Res, comp, 2.7K ±10%, 1/2W | 4704-108837 | 01121 | EB2721 | 1 | | B |
| R529 | Res, comp, 22M ±10%, 1/2W | 4704-108233 | 01121 | EB2261 | 1 | | |
| R530, R531 | Res, WW, 547Ω ±0.1%, 1/4W | 4707-159772 | 15909 | Type R1136 | 2 | | |
| R532, R533 | Res, met flm, 51.1K ±1%, 1/2W | 4705-159665 | 75042 | Type CEC-TO | 2 | | |
| R534 | Res, comp, 330Ω ±10%, 1/2W | 4704-108589 | 01121 | EB3311 | REF | | |
| R535 | Res, comp, 1K ±10%, 1/2W | 4704-108563 | 01121 | EB1021 | 2 | | |
| R536 | Res, comp, 1.5M ±10%, 1/2W | 4704-108175 | 01121 | EB1551 | 1 | | |
| R537 | Res, comp, 10K ±5%, 1/2W | 4704-109165 | 01121 | EB1035 | REF | | |
| R538 | Res, met flm, 10K ±1%, 1/2W | 4705-151274 | 75042 | Type CEC-TO | 1 | | |
| R539 | Res, var, WW, 3K ±20%, 2W | 4702-153429 | 71450 | Type 115 | 1 | | |
| R540 | Res, met flm, 5.11K ±1%, 1/2W | 4705-159657 | 75042 | Type CEC-TO | 1 | | |
| R541 | Res, comp, 1.1Ω ±5%, 1/2W | 4704-163717 | 01121 | EB11G5 | 1 | | |
| R542 | Res, comp, 10K ±5%, 1/2W | 4704-109165 | 01121 | EB1035 | REF | | |
| R543 | Res, comp, 24K ±5%, 1/2W | 4704-108654 | 01121 | EB2435 | 1 | | |
| R544 | Res, comp, 130Ω ±5%, 1W | 4704-163055 | 01121 | GB1315 | 1 | | |
| R545 | Res, comp, 1K ±10%, 1/2W | 4704-108563 | 01121 | EB1021 | REF | | |

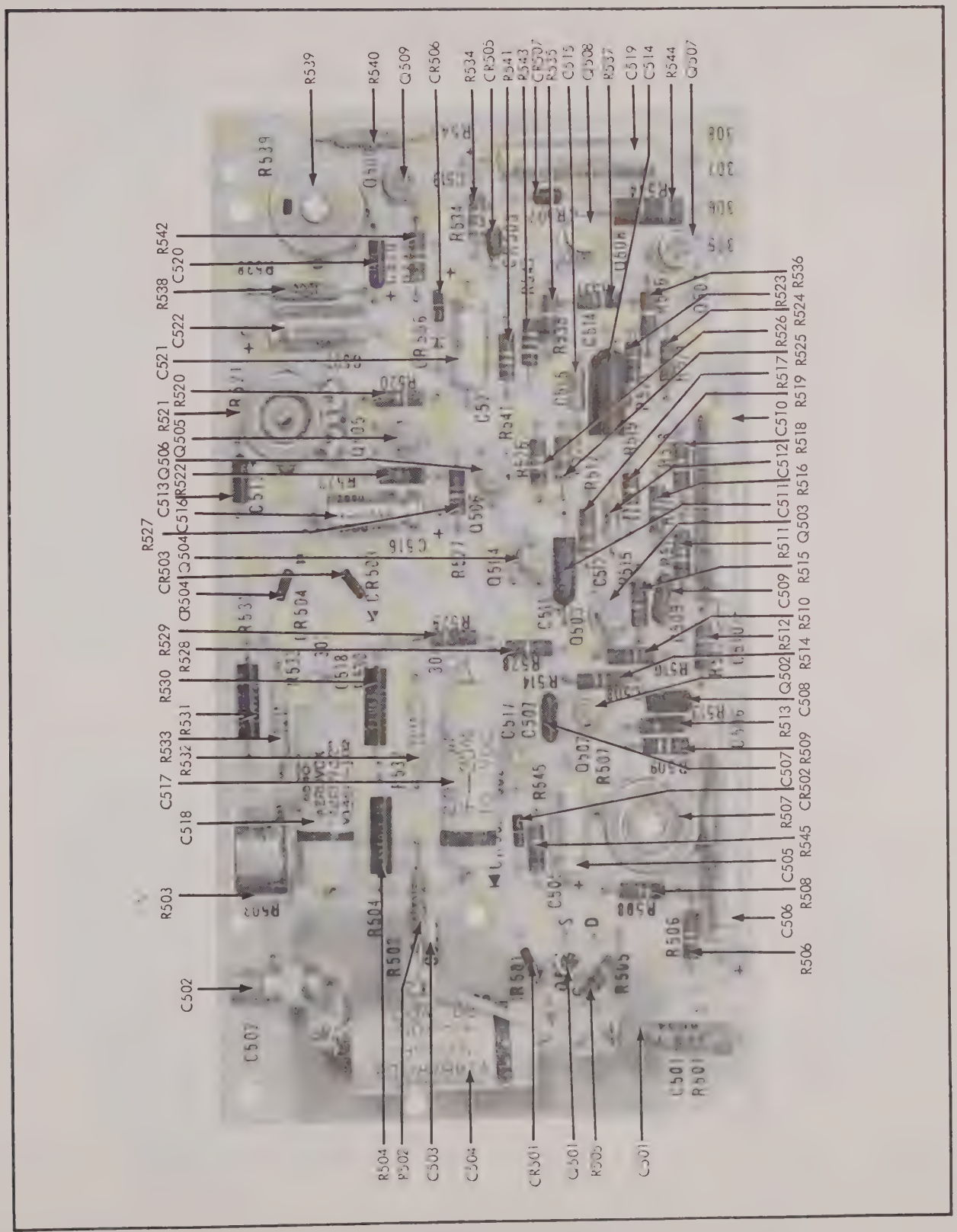



Figure 5-8. CONVERTER ASSEMBLY

## 5-8. USE CODE EFFECTIVITY

5-9. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the 873A. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123. New codes will be added as required by instrument changes.

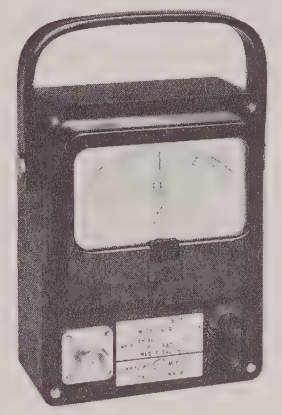
| USE CODE | EFFECTIVITY |
|---|---|
| No Code | Model 873A and 873AB serial number 123 and on |
| A | Model 873A and 873AB serial number 123 thru 197 |
| B | Model 873A and 873AB serial number 198 and on |
| C | Model 873A and 873AB serial number 300 and on |
| D | Model 873A and 873AB serial number 256, 282, 291 thru 294, 296, 298, 299, 301, 302, 305, 307 and on |
| E | Model 873A and 873AB serial number 308 and on |
| F | Model 873A and 873AB serial number 123 thru 134 |
| G | Model 873A and 873AB serial number 468 and on |
| H | Model 873A and 873AB serial number 123 thru 159 |
| J | Model 873A and 873AB serial number 160 and on |
| K | Model 873A and 873AB serial number 123 thru 195 |
| L | Model 873A and 873AB serial number 196 and on |
| M | Model 873A and 873AB serial number 123 thru 307 |
| N | Model 873A and 873AB serial number 123 thru 307 |
| O | Model 873A and 873AB serial number 135 thru 344, 368 thru 399 |
| P | Model 873A and 873AB serial number 345 thru 367, 400 and on |
| R | Model 873A and 873AB serial number 123 thru 467 |
| S | Model 873A and 873AB serial number 196 thru 529 |
| T | Model 873A and 873AB serial number 530 and on |
| U | Model 873A and 873AB serial number 160 thru 529 |
| V | Model 873A serial number 123 thru 656<br>Model 873AB serial number 123 thru 552 |
| W | Model 873A serial number 657 and on<br>Model 873AB serial number 553 and on |
| X | Model 873A and 873AB serial number 1133 and on |
| Y | Model 873A and 873AB serial number 123 to 1131 |
| Z | Model 873A and 873AB serial number 1132 and on |
| AA | Model 873A and 873AB serial number 308 to 1052 |
| AB | Model 873A and 873AB serial number 1053 and on |
| AC | Model 873A and 873AB serial number 198 to 802 |
| AD | Model 873A and 873AB serial number 803 and on |
| AE | Model 873A and 873AB serial number 524, 529, 530, 538, 542, 544, 545, 548 and on |
| AF | Model 873A and 873AB serial number 123 to 1052 |
| AG | Model 873A and 873AB serial number 1338 and on |

# SECTION VI

# ACCESSORIES

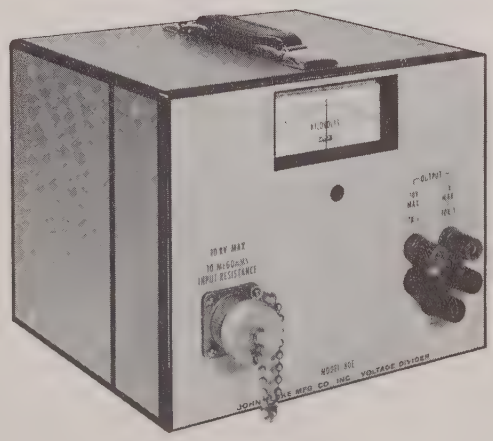
6-1. PRECISION VOLTAGE DIVIDERS

6-2. The FLUKE 80A, 80D, and 80E Voltage Dividers provide the FLUKE 800 Series Differential Voltmeters with the ability to make high accuracy measurements up to 30,000 volts DC. All models contain a zero center panel meter which allows the polarity and approximate magnitude of the unknown high voltage to be easily observed. At maximum input, all units draw but 1 ma of current from the unknown. The extreme accuracy and excellent long term stability of these dividers are obtained by using properly aged precision wirewound resistors which have a very low temperature coefficient. To further ensure high accuracy and long term stability at very high voltages, the 80D dividers have all resistance components immersed in oil within a hermetically sealed container. As an additional feature, all 80D and 80E models are provided with a 1 volt tap which allows measurements of high voltages with a laboratory potentiometer. Specifications for the standard models are shown on next page. Other intermediate models are available upon special request.



MODEL 80A

MODEL 80D



MODEL 80E

| Model No. | Maximum Input Voltage | Total Resistance | Current Drawn At Max. Input | Division Ratio | | | Division Ratio Accuracy | Stability of Division Accuracy Per Year |
|---|---|---|---|---|---|---|---|---|
| | | | | 500V Out | 10V Out | 1V Out | | |
| 80A-1 | 1 KV | 1 M | 1 ma | 2:1 | —— | —— | ±0.015% | —— |
| 80A-2 | 2 KV | 2 M | 1 ma | 4:1 | —— | —— | ±0.015% | —— |
| 80E-5 | 5 KV | 5 M | 1 ma | — | 500:1 | 5,000:1 | ±0.01% | ±0.01% |
| 80E-10 | 10 KV | 10 M | 1 ma | — | 1000:1 | 10,000:1 | ±0.01% | ±0.01% |
| 80D-30 | 30 KV | 30 M | 1 ma | 60:1 | 3000:1 | 30,000:1 | ±0.01% | ±0.01% |

| MODELS | SIZE | INPUT CONNECTOR | OUTPUT CONNECTOR |
|---|---|---|---|
| 80A | 6-3/4" high<br>5-1/4" wide<br>2-1/4" deep | UG-560U with mating connector supplied | Insulated binding posts on 3/4" centers |
| 80E | 7" high<br>8-1/2" wide<br>8" deep | MS3102A-18-165 with mating connector supplied | Insulated binding posts on 3/4" centers for both outputs |
| 80D | 13" high<br>9-3/4" wide<br>16" deep | Special 5" ceramic standoff with mating 6" guard supplied | Insulated binding post on 3/4" centers for both outputs |

MODEL A88 ISOLATION AMPLIFIER

6-3. ISOLATION AMPLIFIER

6-4. The FLUKE Model A88 all solid-state isolation amplifier is designed to provide isolation between the output of a differential voltmeter and the input of a recorder. Thus, the A88 will allow the use of a wide range of strip chart recorders for recording the voltmeter reading without regard to the input isolation characteristics of the recorder. The A88 is also excellent for making accurate dc microvolt and nanoampere measurements in the presents of common mode voltages up to 1100 vdc and 3 vac, 50 to 500 cycles.

GAIN: 1 volt output per microampere input.

GAIN ACCURACY: ±2%.

INPUT CURRENT RANGE: 0 to 2 microamperes.

INPUT VOLTAGE RANGE: 0 to 2 millivolts nominal.

INPUT RESISTANCE: 950 ohms (±5%).

OUTPUT VOLTAGE RANGE: 0 to 2 volts open circuit.

OUTPUT RESISTANCE: 1000 ohms (±5%).

INPUT ISOLATION FROM CHASSES: Greater than $5 \times 10^{11}$ ohms at 25°C (77°F), 60% RH and $1 \times 10^{10}$ ohms at 50°C (122°F), 80% RH.

# APPENDIX A

# FEDERAL SUPPLY CODE FOR MANUFACTURERS

## A-1. CODE TO NAME

**A-2.** The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name. Suppliers not listed in the Federal Supply Code for Manufacturers have been assigned an alphabetical code by FLUKE.

| | |
|---|---|
| 00213 | Sage Electronics Corp.<br>Rochester, New York |
| 00327 | Welwyn International, Inc.<br>Cleveland, Ohio |
| 00656 | Aerovox Corp.<br>New Bedford, Massachusetts |
| 01121 | Allen-Bradley Company<br>Milwaukee, Wisconsin |
| 01281 | Pacific Semiconductors Inc.<br>Lawndale, California |
| 01295 | Texas Instruments, Inc.<br>Semiconductor Components Div.<br>Houston, Texas |
| 01730 | Circle Mfg. Co. Inc.<br>Little Falls, New Jersey |
| 01884 | Dearborn Electronic Labs Inc.<br>Orlando, Florida |
| 01963 | Cherry Electrical Products Corp.<br>Highland Park, Illinois |
| 02660 | Amphenol-Borg Elect. Corp.<br>Chicago, Illinois |
| 02606 | Fenwal Laboratories Inc.<br>Framington, Massachusetts |
| 02799 | Arco Capacitors, Inc.<br>Los Angeles, California |
| 03614 | Bussmann Mfg. Div. of<br>McGraw-Edison Co.<br>Los Angeles, California |
| 03615 | Ohmite Mfg. Co.<br>Los Angeles, California |
| 03877 | Transitron Electronic Corp.<br>Wakefield, Massachusetts |
| 03911 | Clairex Corp.<br>New York, New York |
| 03980 | Muirhead Instruments, Inc.<br>Mountainside, New Jersey |
| 04009 | Arrow Hart and Hegemen<br>Electronic Company<br>Hartford, Connecticut |
| 04062 | Elmenco Products Company<br>New York, New York |
| 04202 | Winchester Electronics Co.<br>New Milford, Connecticut |
| 04221 | Telex-Aemco Division<br>of Telex Corp.<br>Mankato, Minnesota |
| 04645 | Kurz-Kasch, Inc.<br>Chicago, Illinois |
| 04713 | Motorola Inc.<br>Semiconductor Products Division<br>Phoenix, Arizona |
| 05082 | Tung-Sol Electric Inc.<br>Melrose Park, Illinois |
| 05278 | Penn-East Engrg. Corp.<br>Kutztown, Pennsylvania |
| 05397 | Union Carbide Corp. Linde<br>Division Kemet Dept.<br>Cleveland, Ohio |
| 05571 | Sprague Electric Company<br>Culver City, California |
| 05704 | Alac, Inc.<br>Glendale, California |
| 06001 | General Electric Company<br>Capacitor Department<br>Irmo, South Carolina |
| 06136 | Ward Leonard Electric Co.<br>Los Angeles, California |
| 06473 | Amphenol Space and Missile Sys<br>Chatsworth, California |
| 06555 | Beede Electrical Inst. Co.<br>Penacook, New Hampshire |
| 06751 | Nuclear Corporation of<br>America, Inc.<br>U. S. Semcor Div.<br>Phoenix, Arizona |
| 06860 | Gould National Batteries Inc.<br>La Puente, California |
| 07115 | Corning Glass Works<br>Electronic Components Dept.<br>Bradford, Pennsylvania |
| 07263 | Fairchild Semiconductor<br>Div. of Fairchild Camera<br>and Instrument Corp.<br>Mountain View, California |
| 07344 | Bircher Co., Inc.<br>Rochester, New York |
| 07792 | Lerma Engineering Corp.<br>Northampton, Massachusetts |
| 07910 | Continental Device Corp.<br>Hawthorne, California |
| 08530 | Reliance Mica Corp.<br>Brooklyn, New York |
| 08863 | Nylomatic Corp.<br>Morrisville, Pennsylvania |
| 08988 | Skottie Electronics Inc.<br>Peckville, Pennsylvania |
| 11237 | Chicago Telephone of Calif Inc.<br>South Pasadena, California |
| 11503 | Keystone Mfg. Co.<br>Warren, Michigan |
| 12060 | Diodes, Inc.<br>Chatsworth, California |
| 12136 | Philadelphia Handle Co.<br>Camden, New Jersey |
| 12400 | International Resistance Co.<br>Control Components Division<br>Philadelphia, Pennsylvania |
| 12617 | Hamlin Inc.<br>Lake Mills, Wisconsin |
| 12697 | Clarostat Mfg. Co.<br>Dover, New Hampshire |
| 14099 | Semtech Corp.<br>Newbury Park, California |
| 14193 | California Resistor Corp.<br>Santa Monica, California |
| 14298 | American Components Inc.<br>Conshohocken, Pennsylvania |
| 14752 | Electro Cude Inc.<br>South Pasadena, California |
| 15818 | Amelco Inc.<br>Mountain View, California |
| 15909 | Daven Division<br>Thomas A. Edison Ind.<br>McGraw Edison Co.<br>Livingston, New Jersey |
| 16332 | Milwaukee Relays Inc.<br>Cedarburg, Wisconsin |
| 16473 | Cambridge Scientific<br>Industries Inc.<br>Cambridge, Maryland |
| 17069 | Circuit Structures Lab<br>Santa Ana, California |
| 17856 | Siliconix Inc.<br>Sunnyvale, California |
| 17910 | Continental Device Corp.<br>Hawthorne, California |
| 18083 | Clevite Corp.<br>Transistor Division<br>Palo Alto, California |
| 19429 | Montronics, Inc.<br>Seattle, Washington |
| 19701 | Electra Mfg. Co.<br>Independence, Kansas |
| 24655 | General Radio Co.<br>West Concord, Mass. |
| 28520 | Heyman Mfg. Co.<br>Kenilworth, New Jersey |
| 33173 | General Electric Co.<br>Tube Dept.<br>Owensboro, Kentucky |
| 37942 | P. R. Mallory and Co., Inc.<br>Indianapolis, Indiana |
| 38315 | Honeywell Inc.<br>Precision Meter Division<br>Manchester, New Hampshire |
| 42498 | National Company, Inc.<br>Malden, Massachusetts |
| 44655 | Ohmite Mfg. Co.<br>Skokie, Illinois |
| 49671 | Radio Corp. of America<br>New York, New York |
| 53021 | Sangamo Electric Co.<br>Springfield, Illinois |
| 55026 | Simpson Electric Company<br>Chicago, Illinois |
| 56289 | Sprague Electric Co.<br>North Adams, Mass. |
| 58474 | Superior Electric Co.<br>Bristol, Connecticut |
| 60399 | Torrington Mfg. Co.<br>Torrington, Connecticut |
| 62460 | USHCO Mfg. Co., Inc.<br>Buffalo, New York |
| 64834 | West Mfg. Co.<br>San Francisco, California |
| 65092 | Weston Instruments<br>Div. of Daystrom, Inc.<br>Newark, New Jersey |
| 66150 | Winslow Tele-Tronics Inc.<br>Asbury Park, New Jersey |
| 70563 | Amperite Co.<br>Union City, New Jersey |
| 70903 | Belden Mfg. Co.<br>Chicago, Illinois |

71400 Bussman Manufacturing
Division of McGraw Edison Co.
St. Louis, Missouri

71450 CTS Corp.
Elkhart, Indiana

71468 Cannon Electric Company
Los Angeles, California

71482 Clare, C. P. and Company
Chicago, Illinois

71590 Centralab Div. of Globe
Union, Inc.
Milwaukee, Wisconsin

71707 Coto Coil Co., Inc.
Providence, Rhode Island

71744 Chicago Miniature Lamp
Works
Chicago, Illinois

71785 Cinch Mfg. Co. and
Howard B. Jones Div.
Chicago, Illinois

72005 Driver, Wilber B., Co.
Newark, New Jersey

72092 Eitel-McCullough, Inc.
San Bruno, California

72136 Electro Motive Mfg. Co.
Willimantic, Connecticut

72354 Fast, John E. Co.
Div. of Victoreen Instr. Co.
Chicago, Illinois

72559 Essex Electronics Inc.
Berkeley Heights, New Jersey

72619 Dialight Corp.
Brooklyn, New York

72665 Mallory Battery Company
Cleveland, Ohio

72982 Erie Tech. Products Inc.
Erie, Pennsylvania

73138 Helipot Division of
Beckman Instruments Inc.
Fullerton, California

73293 Hughes Products Div. of
Hughes Aircraft Co.
Newport Beach, California

73445 Amperex Electronic Co.
Div. of North American
Philips Co., Inc.
Hicksville, New York

73559 Carling Electric Inc.
Hartford, Connecticut

73586 Circle F Mfg. Co.
Trenton, New Jersey

73899 JFD Electronics Corp.
Brooklyn, New York

73949 Guardian Electric Mfg. Co.
Chicago, Illinois

74217 Radio Switch Corp.
Marlboro, New Jersey

74306 Piezo Crystal Company
Carlisle, Pennsylvania

74542 Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970 Johnson, E. F., Co.
Waseca, Minnesota

75042 International Resistance Co.
Philadelphia, Pennsylvania

75915 Littelfuse Inc.
Des Plaines, Illinois

76854 Oak Mfg. Co.
Crystal Lake, Illinois

77342 American Machine
and Foundry Company
Potter & Brumfield Div.
Princeton, Indiana

77969 Rubbercraft Corp. of
California Ltd.
Torrance, California

78277 Sigma Instruments, Inc.
South Braintree, Mass.

79136 Waldes Kohinoor Inc.
Long Island City, New York

79497 Western Rubber Company
Goshen, Indiana

80031 Mepco Division of
Sessions Clock Co.
Morristown, New Jersey

80294 Bourns Laboratories, Inc.
Riverside, California

80583 Hammarlund Company, Inc.
New York, New York

80640 Stevens, Arnold Co., Inc.
Boston, Massachusetts

81073 Grayhill Company
La Grange, Illinois

81439 Therm-O-Disc Inc.
Mansfield, Ohio

81483 International Rectifier Corp
El Segundo, California

81590 Korry Mfg. Co.
Seattle, Washington

82376 Astron Division
Renwell Industries Inc.
East Newark, New Jersey

82389 Switchcraft Inc.
Chicago, Illinois

82872 Roanwell Corp.
Brooklyn, New York

82877 Rotron Mfg. Co., Inc.
Woodstock, New York

82879 Royal Electric Corp.
Pawtucket, Rhode Island

83003 Varo Mfg. Co., Inc.
Garland, Texas

83298 Bendix Corp.
Red Bank Division
Red Bank, Eatontown,
New Jersey

83330 Smith, Herman H., Inc.
Brooklyn, New York

83478 Rubbercraft Corp. of Am.
New Haven, Connecticut

84411 Good All Electric Mfg. Co.
Ogallala, Nebraska

86689 R. M. B. Corp.
Los Angeles, California

88419 Cornell-Dubilier Elec. Corp.
Electro-Mechanical Div.
Fuquay Springs,
North Carolina

88690 Essex Wire Corp.
R. B. M. Division
Detroit, Michigan

89536 Fluke, John, Mfg. Co., Inc.
Seattle, Washington

89730 General Electric Company
Newark Lamp Works of
Lamp Division of Consumer
Products Group
GECO
Newark, New Jersey

90205 Best Stamp and Mfg. Co.
Kansas City, Missouri

90211 Square D Company
Chicago, Illinois

90303 Mallory Battery Company
North Tarrytown, New York

91293 Johanson Mfg. Co.
Boonton, New Jersey

91407 Superior Electric Company
Oak Park, Illinois

91662 Elco Corp.
Willow Grove, Penn.

91737 Gremar Mfg. Co., Inc.
Wakefield, Massachusetts

91802 Industrial Devices, Inc.
Edgewater, New Jersey

91929 Minneapolis Honeywell
Regulator Company
Micro Switch Division
Freeport, Illinois

91934 Miller Electric Co., Inc.
Pawtucket, Rhode Island

93332 Sylvania Electric Products Inc.
Semiconductor Products Division
Woburn, Massachusetts

94145 Raytheon Company
Semiconductor Division
California Street Plant
Newton, Massachusetts

95146 Alco Electronics Mfg. Co.
Lawrence, Massachusetts

95264 Lerco Electronics Inc.
Burbank, California

95303 Radio Corp. of America
Comm. Receiving Tube &
Semiconductor Division
Cincinnati, Ohio

95354 Methode Mfg. Co.
Chicago, Illinois

95712 Dage Electric Co., Inc.
Franklin, Indiana

96733 San Fernando Electric Mfg. Co.
San Fernando, California

96881 Thomson Industries, Inc.
New Hyde Park
Long Island, New York

97945 S. S. White Dental Mfg. Co.
Plastics Division
New York, New York

97966 CBS Electronics Div. of
Columbia Broadcasting
System, Inc.
Danvers, Massachusetts

98094 Penta Laboratories, Inc.
Santa Barbara, California

98388 Accurate Sales Company
Culver City, California

98743 James Vibrapower Corp.
Chicago, Illinois

98925 Semiconductor Division
of Clevite Corp.
Waltham, Massachusetts

99120 Plastic Capacitors, Inc.
Chicago, Illinois

99217 Southern Electronics Corp.
Burbank, California

99515 Marshall Industries
Electron Prod. Div.
Pasadena, California

Revised May 15, 1966
Using H4-2 Dated March 1963

# WARRANTY

The JOHN FLUKE MFG. CO., INC. warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken.

1. Notify the John Fluke Mfg. Co., Inc., giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

## SHIPPING

All shipments of John Fluke Mfg. Co., Inc. instruments should be made via Railway Express prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

## CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc. Upon receipt of this report you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc. will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to:

JOHN FLUKE MFG. CO., INC., P. O. BOX 7428, SEATTLE 33, WASHINGTON

# International Representatives

**AUSTRALIA**

Elmesco Instruments
41 Carter Road
Brookvale, N.S.W., Australia

**AUSTRIA**

Omni Ray AG
Techn. Beratung
Mollardgasse 54
Vienna VI, Austria

**BELGIUM**

C. N. Rood S/A
30 Rue Leon Frederic
Brussels 4, Belgium

**DENMARK**

Tage Olsen A/S
Ronnegade 1-0
Copenhagen, Denmark

**FINLAND**

Oy Findip AB Ltd.
Mannerheimintie 29C
Helsinki 25, Finland

**FRANCE**

S. E. R. I. E. L., s. a.
48 Avenue Victor Hugo
Clamart (Seine) France

**HONG KONG and MACAO**

Intronics Ltd.
4 Hankow Road, Suite 4A
Kowloon, Hong Kong

**ISRAEL**

R. D. T. Electronics
Engineering Ltd.
P.O. Box 21082
13 Dov-Hos Street
Tel-Aviv, Israel

**ITALY**

Elettronucleonica s. p. a.
7 Pizza DeAngli
20146 Milano, Italy

**JAPAN**

Toyo Trading Co., Ltd.
Central P.O. Box 999
Tokyo, Japan

Toyo Trading Co., Ltd.
4-37, Minamihonmachi
Higashika, Osaka, Japan

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M. - C International
Room 516, Bando Building
Seoul, Korea

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Post Office Box 4542
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Fluke Nederland N. V.
Post Office Box 5053
Tilburg, The Netherlands

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Sample Electronics (N. Z.) Ltd.
8 Matipo Street
Onehunga
Auckland, New Zealand

**NORWAY**

Morgenstierne & Co. A/S
Wesselsgt. 6
Oslo, Norway

**OKINAWA**

RYUKYU ISLANDS

Baxter Trading Co.
P.O. Box 26
Koza, Okinawa
Ryukyu Islands

**PHILIPPINES**

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Makati, Rizal
Manila, Philippines

**SOUTH AFRICA**

A. C. Gowlett (Pty.) Ltd.
P.O. Box 1257
Johannesburg, So. Africa

A. C. Gowlett (Pty.) Ltd.
P.O. Box 3641
Cape Town, So. Africa

A. C. Gowlett (Pty.) Ltd.
P.O. Box 2143
Durban, Natal, So. Africa

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216 Hien-Vuong
P.O. Box H-3
Saigon, Vietnam

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REMA
Calle General Sanjurjo, 18
Madrid, Spain

**SWEDEN**

Robert E. O. Olsson
Box 165
Tradgardsgatan 7
Motala, Sweden

**SWITZERLAND**

Omni Ray AG
Dufourstrasse 56
8008 Zurich, Switzerland

**TAIWAN**

Heighten Scientific Co., Ltd.
P.O. 1408
Taipei, Taiwan

**THAILAND**

G. Simon Radio Ltd.
30 Patpong Avenue
Suriwong
Bangkok, Thailand

**THE UNITED KINGDOM**

Fluke International Corp.
P.O. Box 102
Watford-Herts, England

**WEST GERMANY**

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West Germany

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Ernst - Reuter - Platz 10
West Germany

Rohde & Schwarz Vertriebs - Gmbh
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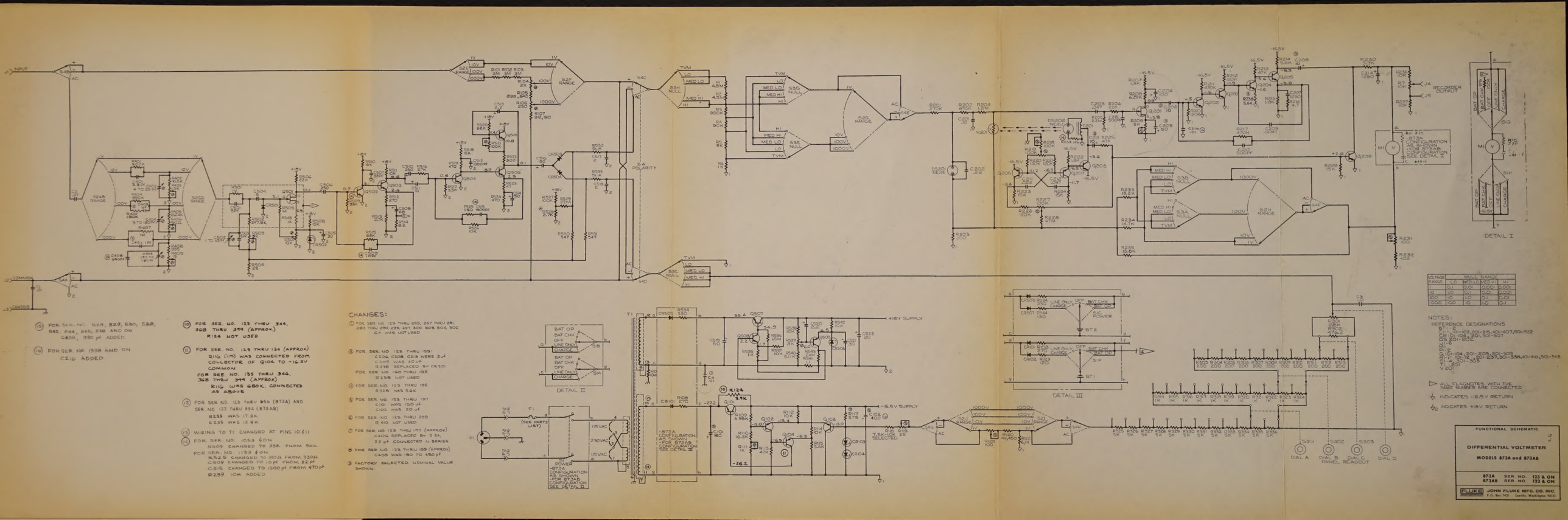
Kriegsstrasse 39
West Germany

Rohde & Schwarz Vertriebs - Gmbh
8000 Muenchen
Dachauer Strasse 109
West Germany

**In Europe contact FLUKE NEDERLAND, N. V., Post Office Box 5053, Tilburg, The Netherlands**

FLUKE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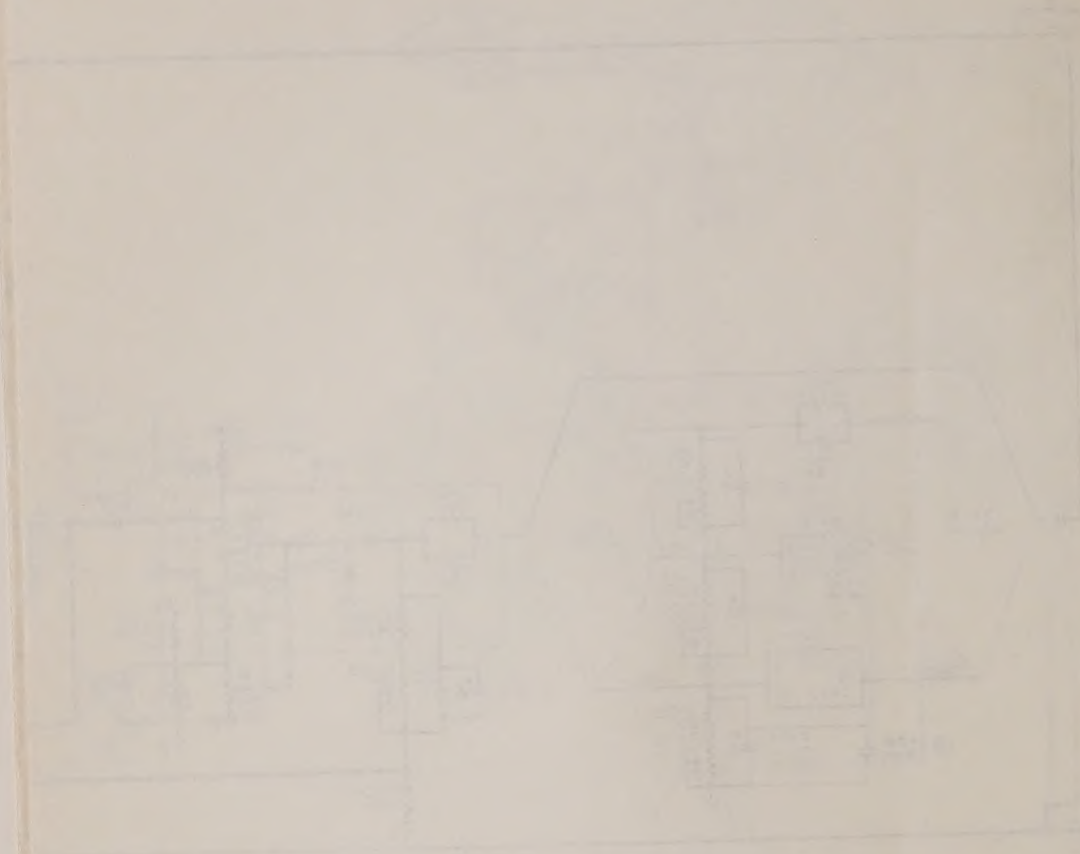

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